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Coconut Stem Bleeding Disease.

The news of the attack of a disea e upon the coconut, a tree occupying 750,000 acres in the island, furnishing a very important part of our food-supply, and one of the staples of village cultivation, has aroused great interest and some alarm. After very careful consideration, the Government has decided to proclaim the disease under the Pests Ordinance, and it may be taken for granted, we imagine, that the local Pests Boards will place no obstacle in the way of carrying out the simple measures proposed, viz: cutting out the diseased parts, scorching the wound, and tarring it. One or two points require careful attention. The diseased part, especially if there be any marked bleeding, will often be found to run a good way up and down the tree, and must of course be all removed. The diseased part sometimes seems to end, and then begin again an inch or two further on. After all has, apparently, been cut out, a cut should be made an inch or two further on to make sure that this is not the case. A small torch, or better a painter's lamp, as used for scorching paint, should be used, and the tar should be hot.

There seems no reason for serious alarm. The disease is being taken at its commencement and should soon be in the same state as Cacao Canker, which is no longer regarded as a serious menace, but simply as costing so much a year to keep under.

GUMS, RESINS, SAPS AND EXUDATIONS.

NEW SPECIES OF MANIHOT AND THEIR IMPORTANCE.

By Dr. Ule.

[Translated by R. H. Lock.]

No. 10 of the "Pflanzer" for August of the present year contained brief notices of three new species of Manihot, which, until more exactly determined, may be designated Jequié Manihot, Piauhy Manihot, and Rio São Francisco Manihot. The appearance of Dr. Ule's communication to the Bahia-Indiarubber Syndicate of Leipzig now enables us to give a more complete account of the new rubber trees; and the interest and importance of the contents of this communication justifies our reproducing it in full.* The following is Dr. Ule's paper:—

In his paper "Die Kautschukpflanzen, eine Wirtschafts-geographische Studie" in the supplement to the "Tropenpflanzer" for 1905 Peter Reintgen states:

"Until four years ago *Manihot glaziovii* was reckoned the only rubber-yielding species of its genus. In 1901, however, Prof. Loefgren, Director of Botanic Garden at São Paulo, discovered that a second species (*Manihot violacea Mull Arg.*) was by no means inferior in quality to the familiar Ceara rubber."

This new rubber plant has not, however acquired any importance on account of its being an herbaceous plant from which it does not pay to extract the rubber either in the wild condition or in cultivation. But as so often happens in the case of problems connected with rubber, small facts may lead to important discoveries.

For some years past attention has been drawn to the steadily increasing output of rubber by the Brazilian State of Bahia, and orders were issued by the German Government to its Consuls to inquire into the cause of this increase. And it was found to depend upon the output, not of *Hancornia speciosa*, the Mangabeira, but of Manicoba, hitherto regarded as being simply *Manihot glaziovii*.

During my journey to Bahia in the summer of 1906, however, on behalf of the Bahia Rubber Syndicate of Leipzig, I examined more closely into the Caoutchouc-districts of Manihot, and it became clear that several species of Manihot have to be reckoned with. Several journeys into the interior of Bahia have clearly established this opinion, and I have now arrived at results of considerable interest.

My observations show that there are two different rubber-producing species of Manihot in the interior of Bahia. One of these grows upon the mountains upon the right bank of the Rio Saõ Francisco, the other occurs only at a considerable distance from the left bank, and is much more abundant in the neighbouring State of Piauhy. The latter appears to be the better species of the two.

In the tree-steppes of the Serra do Saõ Ignazio the Mangabeira is frequent, often occurring in fine thickets. A species of Manicoba is also sometimes to be found in the immediate neighbourhood of this rubber plant, but more usually it grows in the rock-formation, thus demonstrating its claim to be regarded as a true mountain plant.

The Manicoba Species of Manihot.

The number of species of the genus Manihot hitherto described is 82, of which number 72 are found in Brazil. In addition to these there are seven newly proposed by myself including two from the Amazon, and in the herbarium there still lie numerous undescribed species, so that the number will soon exceed 100.

The species show numerous differences in the form of the leaves and in the shape of the flowers and fruit, and they often differ in habit as well. A few are small, often prostrate herbs, others are undershrubs, whilst shrubs and trees are also found. It is the latter group which requires consideration as yielding indiarubber, and such trees are called Manicoba by the natives. The Manicoba species belong to different divisions of the genus Manihot and exhibit differences both in their structure and in their caoutchouc.

Manihot Dichotoma, Ule.

This species does not grow into so tall a tree as *Manihot glaziovii*, and varies between 5 and 12 metres in height; the growth of the crown is, moreover, much more compact and usually thickly branched in a dichotomous fashion. The stem also is not so thick, the bark is thinner and usually paler, although a

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* The attention already aroused by these new Manihot species is shown by the facts that the seed brought by Dr. Ule from Brazil has been sent by the Central Botanical Institute for the Colonies to the Government Stations in the Colonies for experiment, that the Committee of Colonial Industries has brought seed from Bahia and distributed it to the various companies, and that several Rubber Planting Companies have already made large purchases of seed on their own initiative.

dark variety also exists. The leaves of *M. dichotoma* are tri- or quinque-partite, and only in the seedlings are they more or less peltate. Indentations more or less lyrate in form soon appear at the tip of the leaf, such as never appear in the much larger leaves of *M. glaziovii.* Besides other distinctions, the large elongated seeds are especially noteworthy.

The area of distribution of this rubber plant is confined to South East Bahia between 12½ and 14½ degrees south latitude, where it stretches from the banks of the Rio Paraguassu to half way down the Rio das Contas. The plant is sometimes called Maniçoba von Jequié, after the town of Jequié situated in this region, which is the central market for the rubber produced from this plant.

Here it grows in the true Catinga,* and is especially abundant on the mountain spurs which may be called the *mountain Catinga.* The more park-like regions, where individual large trees stand scattered, is avoided by *M dichotoma,* which prefers a rather more thickly wooded Catinga. It develops best on a red loamy soil and is less frequently to be found on a sandy substratum. Within a few miles of Porto Alegre on the Rio das Contas, a central station for the production of rubber for this species of Manihot, I have seen mountain spurs covered so thickly with this tree that it made up almost half the total forest. The caoutchouc obtained annually from *M. dichotoma* in the wild state may be reckoned at 400 to 500 tons at the present time. This does not include plantations, for the discovery of this rubber tree only took place in 1901, and the earliest planted trees are only just coming into condition for tapping.

MANIHOT HEPTAPHYLLA, ULE.

The species of Manicoba which yields most of the rubber from across the Rio São Francisco is quite different in appearance. This species forms only dwarf trees with short stems and wide leafy crowns di- or tri-chotomously branched. The *M. heptaphylla* grows to a height of 2 to 8 metres and has a blackish brown bark; the young twigs and leaf-stalks are a fine purple colour; the leaves are dark green and usually seven-lobed. The fruits are rounded and not angular, the seeds are round like those of *M. glaziovii,* but larger and paler than the latter.

Manihot heptaphylla grows exclusively on the right bank of the Rio São Francisco, between 9½ and 12½ degrees of south latitude, especially in the mountains of the district such as the Serra do Encaibro, Serra do Tombador, Serra do Assurua and others. It is sometimes to be found within a few miles of the right bank of the river, but I have never been able to detect its presence on the left bank. The town of Sentese on the Rio São Francisco is noteworthy at the point of entry to the centre of this rubber district. I have only been able to observe the wild growth in a limited region lying in the Serra do São Iquazio near the town of Chique-Chique. The species grows there among sandstone rocks together with other trees, and Maniçoba and Mangaberia are sometimes to be found not far from one another. There, too, the production of caoutchouc up to the present time may be put at 500 tons a year.

MANIHOT PIAUHYENSIS, ULE.

This species comes near the preceding one in general characters. It forms somewhat lower trees of 2—5 m. in height and has 5-lobed leaves with wide apices. The inflorescences are longer and the fruits angular or winged. The seeds of *M. heptaphylla* and *M. piauhyensis* are scarcely to be distinguished. The area of distribution of *M. piauhyensis* stretches on the south-east of Piauhy along the boundary of Bahia from about 8 to 10 degrees of south latitude. There it grows in the lower mountain spurs, which stretch as far as the South of Ceara. It is to be supposed that this Maniçoba occasionally appears in Bahia a few miles from the left bank of the Rio São Francisco, but I have not been able to obtain definite proof of its presence there. I have been able to observe *M. piauhyensis* in one of its chief areas of distribution and at a few of the central stations of the rubber industry. It grows here on sandstone mountains in a formation to which I have given the name of mountain-shrubs of the dry North. A wide area is here covered with shrubs and trees a few metres in height, and among them are found the small trees of *M. piauhyensis.* They are to be distinguished from the surrounding vegetation by their fresh brilliant green colour. Only scattered individuals are to be seen among the actual rocks, and they seem to grow best on a sandy soil. They often spring up in abundance in places where the woods have been destroyed by burning.

There is considerable difficulty in estimating the quantity of rubber obtained here, because it leaves the country by several routes; part is carried to Theresina through Piauhy itself, part goes to Pernambuco, and the greatest quantity of all to Bahia,

* Deciduous forest, dropping its leaves in the dry season.—ED.

The distance from Rio São Francisco is not too great and the roads are fair, and good means of communication are afforded by the river and from Joazeiro onwards by rail. We shall not be in danger of over-estimating the present export of rubber from this species of Maniçoba at least 600 tons a year.

HARVESTING AND THE YIELD OF RUBBER.

In the method of collecting, *Manihot dichotoma* resembles *Hancornia speciosa* most closely. In the Catinga woods the thickets of this Maniçoba are usually found near villages and close together, so that special huts for the collectors are only required in the more distant parts. The Borrageiro starts in the morning, and just as with the Mangabeira he taps the stronger trees with a sinuous cut using a knife which is either bent at the point or truncated. Sometimes a straight cut is used with or without lateral cuts—a kind of herring-bone tapping. At the lower end a zinc cup is attached to the bark in order to catch the milk. When this milk is collected in vessels it begins at once to coagulate and is moulded with the hands into balls which are usually pressed between rollers and afterwards thoroughly dried.

This method of collecting caoutchouc is carried out by the inhabitants of the neighbouring regions or by people specially enlisted, and this branch of industry is only incumbent upon the collectors who wander round certain so-called reversionary landed property which belongs to the Government.

If the tapping is carried out carefully the wound heals after a time and the tree can be tapped again so that rubber can be gathered three, and, under favourable circumstances, as many as ten, times from a single tree. In the wild state, however, *M. dichotoma* is often carelessly cut by unaccustomed workmen, so that the wood is laid bare. In these cases the stem rots very quickly and the tree dies. In the neighbourhood of Tambury very many dying and dead Maniçoba trees are already to be seen, and it is certain that within a few years the rubber crop will fall off very considerably. *In my opinion the wild thickets of Manihot dichotoma will very soon cease to have any importance as a source of rubber.*

The amount of rubber which a man can gather and prepare in one day varies from one to several pounds. The yearly amount is difficult to determine because very few Borrageiros occupy themselves continuously with gathering rubber, although the trees yield latex throughout the whole year.

In the case of both the other species *M. heptaphylla* and *M. piauhyensis*, the method of obtaining the rubber is almost identical. In these cases it is found that the shorter stem as well as the somewhat thinner bark are not suitable for cutting, and, treated in this way, yield little latex; on the other hand scratching just above the root gives a very good result.

For this purpose a depression is made by removing the earth on one side at the base of the stem. and at this point, just above the insertion of the root, the Maniçoba tree is scarified with a round pointed knife. The latex flows into the hole prepared for it and there coagulates, whence it is gathered by the rubber collectors. Since the rubber obtained in this way is liable to become very much contaminated with sand, the bottom of the hole is often covered with a thin layer of clay, for which purpose that obtained from termite nests is well adapted. This clay can easily be washed away from the small threads of rubber, and thus a fairly, pure product is obtained. After gathering, the rubber requires to be dried in the air for some time before it can be packed in sacks and sent away.

The weight of these rubber threads obtained from a single tapping usually varies from 10 to 100 g. (⅓ oz. to 3 oz.). But I have seen balls of rubber up to 150 g., and it is said that as much as 1 k.g. (2¼ lbs.) is sometimes obtained. The Maniçoba tree is always scratched at the same spot, and endures this method of tapping very well. The yield of rubber from a good tree may be put at 5 k. g. a year.*

The method of obtaining rubber from the Maniçoba in Piauhy is adapted from that employed in the case of *Hevea brasiliensis* on the Amazon, and here too the people concerned with it are called Seringueiros.

Here also so-called Estradas—primitive paths—are laid out, from which 300 to 1,000 trees can be got at. By cutting down the lianes which block the way a sufficient line of passage through the jungle is laid open, and, if possible, the path returns in a circle to the point of departure, whilst it must pass a sufficient number of Maniçoba trees on either side. A Seringueiro taps about 200 trees a day, and it is so arranged that each tree comes upon his route not more than twice a week

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* Or 11 lbs., a figure that one is hardly disposed to accept, even from Dr. Ule, without further evidence.—ED.

Examining the books of the rubber districts of Serra do Lagoa and Serra Nova, I found that a worker gets 1 to 3 kg. a day, and on the average 10 k. g. a week, whilst a very keen worker may collect as much as 20 k. g. I must repeat that very few Seringueiros continue steadily at work; the majority often stop work for weeks or months together.

This yield of Maniçoba rubber does not compare favourably with the amounts obtained by the Seringaes of the Amazon Valley; on the other hand the incidental expenses are less. Both in Piauhy and in Bahia the cost of living is much cheaper than in the region of the Amazon Valley, where it often reaches a very high figure.

In Piauhy and Bahia the rubber thickets lie in the mountains, widely separated as a rule from the villages. The Seringueiros therefore erect special ranchos—primitive refuge huts in which they live during the rubber collecting season, either alone or with their families. Food, and sometimes water as well, have often to be brought from a considerable distance.

Sometimes the Seringueiro lays out a small garden with vegetables, and he may obtain some part of his requirements by hunting.

My time being limited, I was only able to investigate in a hurried way the method of obtaining rubber from *Manihot heptaphylla* in the mountains on the right bank of the Rio São Francisco. It agrees in the main with that for *Manihot piauhyensis*, and is only rather less fully developed. Nor was I able to obtain any definite figures with regard to its productiveness. The Government Secretary, whose authority may be relied on, assured me that a good Maniçoba tree on the São Francisco produces 1 k. g. a year, an estimate which agrees very well with my observations in Piauyh. I have observed less destruction among the wild thickets of this species of Maniçoba, than was the case with *M. dichotoma*; still this tree too, unless special rules of procedure are followed, is likely to die out in the course of years.

THE PLANTING OF MANICOBA.

Since it is obvious that the production of rubber from the wild thickets will become greatly reduced within a measurable time, it will be necessary, if this highly profitable product is to be preserved, to undertake the cultivation of suitable rubber plants.

For this purpose the Mangabeira (Hancornia) is excluded on account of its very slow growth which does not allow of tapping until an age of 20 years is reached.

Soon after the exploitation of wild manihot species for rubber was begun in Bahia, plantations were also started.

Plantations of Maniçoba species have now existed on the Rio São Francisco for some time, and rubber from these has already been placed upon the market. I had the good fortune to see a number of fields of *Manihot piauhyensis*, which were mostly in excellent condition. The first was the property of Mr. Joaõ Rodriguez de Souza in the neighbourhood of Remanso, in which there were 20,000 planted trees of 1 to 3 years old. The small trees, planted 2×2 metres, branched close to the ground and looked very healthy and of a rich dark green colour, a few specimens of *Manihot glaziovii* and *M. dichotoma* and a few rows of *M. heptaphylla* had also been planted for experiment. The latter showed a considerably greater increase in height, and the crown also spread further. They were three years old and 4 to 5 m. height, whereas trees of *Manihot piauhyensis* of the same age were only 3 or 4 metres. It was proposed to tap these trees for the first time in the present year—1907. Another smaller plantation but of older trees was seen in the same neighbourhood.

In addition to these I have examined larger plantations at Jatobasinho near the boundary of Piauhy and at Serra Nova in the same State; these were in a flourishing condition.

Only a single plantation of *Manihot heptaphylla* was shown me in the Serra do São Ignazio. And I have hurriedly examined a few near Villa Nova in the course of my journey. These plantations, too, were well kept and in good condition.

The beginnings of cultivation of the two manihot species of the Rio São Francisco has come about in a similar way to that of *Manihot dichotoma*, except that a sandy soil is preferred for it though one which is not too sterile. Clearing the undergrowth leads to difficulties only for the first year, afterwards the tops of the small trees meet and interchain, and of themselves prevent the growth of other plants.

Tapping for the first time is best carried out after three years from the date of planting, as soon as the trees are mature and when the rainfall has begun to fall off, that is to say about January. The attempt is made to get suitable labourers, who can be allowed to work in accord, this being the only way in which anything can be carried out here. In Piauhy it is found necessary to allow the labourers in payment one-third of the rubber after it has been gathered

and prepared, and for this they obtain the full local price. I happened to be in the neighbourhood of the Serra Nova at the time when a number of people employed on a rubber estate there were being paid; and at my desire I was shown a slip of paper with the account. According to this account ten labourers had gathered 95·7 k.g. of caoutchouc in seven days which comes to 1·367 k.g. per person per day, the value of which was 6 Milreis 180 Reis (reckoning 4 Milreis 500 Reis to the Kilo), so that each worker got 2 Milreis 60 Reis (about 2 shillings). It must be remembered, too, that the workers included women and children, and that the plantation was quite a young one. Still a daily wage of over 2 Milreis is a high one for an adult labourer under the conditions there existing.

The small threads of rubber which always represent the result of a single tapping, have been shown me in quantities and weighed on the average 25 and sometimes 50 g. The tree may be tapped one hundred times in a year. But if it is cut only forty or twenty times, this represents always a yearly crop of half to 2 k.g., that is to say, 1 k.g. of caoutchouc per tree on the average. One Hectare, on which up to 2,500 trees may be planted, will therefore yield 2½ tons of rubber a year.*

Experiments still require to be made with regard to the time of planting, the distance of planting, and the cultivation of the intervening spaces; it is possible that the trees yield better and last longer at wider intervals apart. The methods of tapping and gathering the rubber may also certainly be improved upon. Experiments have already been made with regard to the gathering of the rubber into vessels; but this is not yet carried out as a general practice, because so far a higher price has not been obtained for rubber prepared in this way, and because a difficulty is found in introducing the vessels into the holes. The stem is often thickened at this spot, or stones may be present, which makes the hollowing of the ground a matter of difficulty. These unfavourable conditions may undoubtedly be overcome by rational management.

The system of labour in particular may be improved in many ways. Attention will have to be paid to considerably increasing the amount collected and reducing the proportion earned by the labourers to 25 or 20 per cent. In the case of a proper division of labour a definite area would be attached to each labourer and an overseer or fiscal appointed to each ten or twelve labourers, and he again would receive a definite percentage of the yield.

In the choice of land suitable for the cultivation of Maniçoba species, preference should first of all be given to those which correspond most nearly with the natural conditions of the wild habitat, and if possible they should be in the actual district. In the second place lands may be used for this cultivation which lie at a distance from the Maniçoba district but possess a similar soil and climatic conditions. In the third place may be considered land lying in Foreign countries, and from this point of view it is important to inquire how far these Manihot species can adapt themselves to different conditions under cultivation.

The culture of Manihot species from Bahia is decidedly superior to that of *Manihot glaziovii*. Many years' experience in India, the African colonies and in Brazil itself has demonstrated a number of disadvantages connected with the planting of *Manihot glaziovii*. If the trees are not protected they are liable to be broken down by strong winds. On account of the hard bark, moreover, tapping is very difficult and wounds due to want of skill may cause serious damage; and finally the crop of rubber is not a very high one. If one puts the yield of rubber from *Manihot glaziovii* at 250 g. a year on an average, this amounts to only 100 k. g. to the hectare when planted at a distance of 5 metres.

The Maniçoba species of Bahia are not liable to damage by wind, as they do not grow so tall, whilst some are quite low growing. The tapping, too, offers no serious difficulty.

But the yearly yield of rubber per hectare is very much larger, and will still surpass that of *Manihot glaziovii* even if it is found that wider planting ought to be adopted.

In future the cultivation of Manihot glaziovii *will have to be replaced by that of the Manihot species from Bahia whereever the conditions permit.*

The question which of the three Manihot species is to be preferred depends chiefly upon the nature of the soil, the climatic conditions being pretty uniform. On a heavy clay soil *Manihot dichotoma* is best planted, and on a light sandy soil *Manihot heptaphylla* and *Manihot piauhyensis*.

* 1 k.g.=2¼ lbs., a hectare=2½ acres, so that this represents a ton of rubber a year from 1,000 trees planted on one acre. Such figures are scarcely to be accepted without further evidence.—ED.

Manihot dichotoma has this advantage over the other two species, that its seeds germinate very easily, whilst its caoutchouc fetches a somewhat higher price, the seeds being therefore also somewhat more valuable. On the other hand the productivity of the two species from Rio São Francisco is decidedly greater and the method of planting hitherto adopted is much less prejudicial to the trees.

Whether *Manihot heptaphylla* or *M. piauhyensis* is to be preferred for cultivation cannot yet be asserted with any confidence. On the average the caoutchouc from *Manihot piauhyensis* is somewhat superior to that of *Manihot heptaphylla*, and the tree is sooner ripe for tapping; on the other hand the latter seems to be longer lived.

In Bahia itself no discrimination is yet made, and as a rule that species of Manihot is cultivated which grows wild in the neighbourhood. The culture of *M. piauhyensis*, however, is most widely spread, and continues to extend itself further and further from the Rio São Francisco. *Manihot piauhyensis* would appear to be the most eligible species for cultivation, so long as no special circumstances intervene.

In recent years the planting of *Hevea brasiliensis* has spread to an unexpected extent, so that millions of these trees have already been planted, which will yield a very notable amount of rubber in the immediate future. No doubt the caoutchouc of Hevea is of higher quality and greater elasticity and always fetches a higher price than that of the Manihot species. *Still the cultivation of these species of Manihot presents certain advantages, so that these rubber plants will soon rival Hevea in spite of the greater value of the caoutchouc produced from the latter.**

Hevea brasiliensis cannot be tapped before six years old, and does not give any crop worth speaking of until eight or ten years, whereas the Manihot species give a good yield in the fourth year. The amount of rubber obtainable per hectare is quite as large from *Manihot heptaphylla* and *Manihot piauhyensis* as from Hevea. The working up of the land required for planting rubber is a much simpler matter in the case of Manihot, since it requires much less labour and trouble to clear and cultivate an area of *steppe* than to prepare a block of jungle land form Hevea and keep it clean from the vigorously growing undergrowth and lianes. Besides, the most fertile land must be chosen for Hevea, which is not necessary in the case of the Manihot species.

If, as is probable, the cultivation of *Hevea brasiliensis* will undoubtedly attain the greatest importance for the production of rubber in luxuriant tropical regions, the future has to look to *Manihot heptaphylla* and *Manihot piauhyensis* as the rubber plants for the dry and less fertile areas.—*Tropenpflanzer*, Dec. 1907, p. 86.

[Everyone interested in rubber, and especially in Ceara rubber, should read this paper. The yields are astonishing, and if they should prove reliable, a great difference will be made to the dry north country of Ceylon, where Ceara rubber does well. So far we have only got seed of one new Manihot, but there is a plantation of this at the Peradeniya Experiment Station, and we expect others.—Ed.]

* Ceara rubber is proving to be of higher value.—Ed.

ANOTHER NEW INDIA-RUBBER TREE.

(*Bleekrodea Tonkinensis.*)

According to reports in the newspapers a new india-rubber tree has been discovered in Tonkin. Hitherto the only rubber-producing plants known from Indo-China, and especially Tonkin, were Lianes belonging to the family *Apocynaceae*. The stems of these plants never arrive at any great thickness, and difficulties lie in the way of obtaining rubber from them. The attempt was therefore made to introduce rubber trees such as *Hevea brasiliensis*, *Manihot glaziovii* and *Ficus elastica* into Tonkin, but the result was not satisfactory. Under these circumstances, the discovery of a large india-rubber tree has considerable importance for the Colony. As Messrs. Dubard and Eberhardt briefly pointed out to the Paris Academy, this tree forms thick *Bëstande* over the whole province of Bac-Kan and in the south of the provinces Bao-Lac and Cao-Bang. It reaches a height of 10-15 metres and grows preferably in *Abhangen* where the subsoil consists of *Kalkschiefer* and where there is moist humus, but without stagnant water. Latex obtained from the stem contains a very large amount of Caoutchouc, probably more than that from *Hevea brasiliensis*. The product is of excellent quality and not to be distinguished *im Handel* from the best kinds of Para. The tree belongs to the genus Bleekrodea, Family Moraceae. Only two species of the genus were previously known, one from Madagascar and one from Borneo. The new species has been given the name *Bleekrodea Tonkinensis*.

INDIA-RUBBER CULTIVATION IN BRAZIL.

(*From Der Tropenpflanzer, Dec., 1907.*)

Other South American States such as Equador, Bolivia and Colombia began planting rubber several years ago, and Equador, for example, was able to export as much as 520 tons of plantation rubber in 1904. In Brazil, however, it is only quite recently that any attempt has been made to make up for the diminishing supply of wild rubber by planting Manihot. No cultivation on a large scale exists at present, and such is not to be expected for some time on account of the unfavourable agricultural conditions.

Still, although labour and the necessary means of cultivation are wanting in the greater part of the country, a few favoured regions do not fall under this category, and we observe with pleasure that German enterprise has recently established itself by the Optionsvertrag of large stretches of country, for the purpose of carrying on Rubber cultivation on a large scale. We may refer specially to a private estate of over 500,000 ha., lying between the towns of Razo, Soure and Tucano, the purchase of which by the proposed Bahia India-rubber Company is under consideration.

As Dr. Ule, the expert to the syndicate (?) of this Company, can certify, this region is not only admirably adapted for the cultivation of rubber, but contains already a great wealth of fully grown wild rubber trees. Dr. Ule estimates the Mangabeira trees standing on only four out of the fifteen *Facendas* at 500,000 at least, a circumstance not to be over looked, as it will enable the concern to pay its way even in the first year of its existence before the planted trees are in a condition to be tapped.

The best prospects for cultivation are shown by two species of Manihot newly discovered by Dr. Ule. *Manihot piauhyensis* * n. sp. and *M. Leptaphylla* n. sp. which are perhaps destined to lead the cultivation of rubber into new and wider channels in our own Colonies as well—especially in East Africa.

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* See p. 199.

OILS AND FATS.

CARNAUBA WAX.

A note on this substance appeared in the *Agricultural News* (Vol. II, p. 307), and it was there stated that specimens of the tree producing the wax are to be found in the Botanic Gardens at British Guiana, and that seeds have been distributed from them to the Botanic Stations throughout the West Indies. In a later issue of the *Agricultural News* (Vol. III, p. 284) it is mentioned that enquiries had been received in Demerara for this product, and, judging from the particulars given below, which have been taken from the latest British *Consular Report* on the trade of the Brazilian State of Bahia, carnauba wax may easily become a valuable minor article of commerce. The Consul writes:—

The substance which figures amongst exports from Bahia under the term 'carnauba' is a species of vegetable wax, which is obtained from a palm tree (*Copernicia cerifera*, Mart.) The palm in question grows wild in abundance throughout all parts of this State.

Carnauba wax is an article of high commercial value. It has been used during many years past for the manufacture of fine-quality candles, also during later years as a basis for boot polish. Quite recently, it appears, the discovery has been made that carnauba wax is the most suitable substance for the manufacture of records for phonographs and gramophones, and the additional demand thus created has had the effect of materially increasing the value of the wax in question. At the present time the market prices of carnauba wax range from £170 to £225 per ton.

The value of the wax is dependent upon three factors—tint, texture, and richness in oil, and for trade purposes the wax is graded into three qualities. The first quality is of uniform pale cream tint, smooth and homogeneous in texture, and is rich in oil. The inferior qualities are darker and less rich in oil.

It is probable that it will be discovered, as time goes on, that carnauba wax can be made to serve many useful purposes in addition to those which I have specified.—*Agriculturnl News*, Vol. VI., No. 146, November, 1907, p. 375.

DYES.

SYNTHETIC INDIGO.

The cost of producing a maund (maund = $82\frac{2}{7}$ lbs.) of Synthetic Indigo is believed to be Rs. 90·00, but according to *Capital*, Mr. E. C. Schrottky claims that natural indigo can now be produced at Rs. 60·00 per maund of 65 per cent. indigotine, in which case it would appear that the prospects of the natural product have considerably brightened.—*Indian Trade Journal*, Vol. VII, No. 87, Calcutta, Thursday, 28th November, 1907.

EDIBLE PRODUCTS.

CULTIVATION OF LIMES.

While it cannot be expected that the high prices which have recently been obtained for all lime products will become permanent, it would appear that the future prospects of the lime industry of the West Indies are of a promising nature.

Considerable interest has of late been awakened throughout these colonies in the cultivation of limes, and the progress made in the industry in Montserrat and Dominica has induced the planting of limes in British Guiana, Grenada, Carriacou, and St. Lucia.

With the view of generally encouraging the cultivation of this plant, and of affording all available information for the guidance of lime planters, as to the best methods of cultivating their crops, and preparing the products for market, the Imperial Department of Agriculture has in preparation a pamphlet dealing with the cultivation of the lime plant and the manufacture of its products. As it may be some time, however, before this can be successfully put through the press, it has been thought that a brief summary might with advantage be printed in the *Agricultural News*, in order to afford all assistance possible to those who have taken up, or purpose to take up, the cultivation of limes.

TREATMENT OF LAND.

By far the greater area of lime cultivations in Dominica was established on land which had been growing sugar-cane, and if the plants are allowed a sufficiency of room, by careful removal of cane stools around them, they can successfully be established by means of seedlings, in the cane fields, in the course of a few years.

On some estates, land in grass or guava bush is cultivated, lined, holed, and planted. A circle around the young plant is kept clean, and the remainder of the field cutlassed occasionally. In other cases, the usual garden crops of pigeon peas, tannias, dasheens, cassava, etc., are allowed to grow amongst the young lime plants.

When forest land is to be planted in limes, it is felled, lopped, lined, burned, and then holed, and after planting, a small area around each plant is kept clean, while the bush and grass that spring up in the intermediate spaces are periodically cutlassed.

When lining the fields for planting, it is essential that an efficient system of drainage should be established before any planting is done, and a good system of roads should be outlined in order that the greatest economy in working the estate may be practised. Another matter of importance on exposed land is protection from the full force of the wind, and wind-breaks of pois boux, galba, or other suitable trees should be formed as early as possible. Very often this important work is neglected, and much money thereby lost, for full exposure to the wind has a dwarfing effect on the trees, and a serious effect on the crops.

CHOICE OF LAND.

Lime trees will develop best, and yield the heaviest crops, in rich well sheltered lands, situated from sea-level up to 300 feet elevation, and possessing a rainfall varying from 80 to 160 inches per annum. Limes can also be successfully cultivated on fairly steep slopes, especially if washing away of the soil is prevented by the presence of numerous boulders, and if the soil is fed with vegetable matter from forest land above the cultivation. In Dominica, slopes have been cleared of forest to the top of the ridge, and lime trees have been established, but careful attention must be given to terracing and manuring, if it is desired that such cultivations are to be long-lived.

Lime cultivation is now being carried on in Dominica at elevations of up to 2,000 feet, and in districts possessing a rainfall of over 200 inches per year; and, given good selection of land, with some protection from wind and good cultural methods, there is little doubt that such cultivation should be profitable. But it is generally understood that, as far as the island of Dominica is concerned, the best results are obtained in the coastal and valley lands possessing a light black soil.

PREPARATION OF SEED BEDS, ETC.

It takes from ten to twelve months from the sowing of lime seeds to the time when strong plants are fit for putting out into the field. Seed beds from 4 to 5 feet wide, and as long as desired, with plants set out at distances of from 2 to 3 feet apart, should be prepared on sheltered piece of land. The beds should be raised, so as to ensure good drainage, and the soil should be thoroughly broken up. Nursery beds should also be prepared in the same manner for the reception of the young seedlings, in the proportion of five nursery beds to every

seed bed, and careful attention should be given to keep tillage in order, so as to ensure the development of a good root system.

Seed for planting purposes should be carefully selected from good, healthy, heavy-bearing trees, and should be placed in a fine sieve and kept stirred by hand, while water is poured over it to remove mucilage. The seeds are then dried in the shade, and when dry they should be planted thinly, at a depth of about an inch, in drills, the distance from drill to drill being about 8 or 9 inches. It is important to remember that lime seeds do not retain their vitality very long, and therefore should be sown as soon as possible after washing and drying. When lime seeds are sown unwashed, they are very often destroyed by rats.

When the seedlings are from 4 to 6 inches high, they are ready to be transplanted into the nursery beds. The plants should be carefully lifted with forks, the roots trimmed, and the stem topped, and they should be set out in rows 8 or 9 inches apart, and with the same distance from plant to plant in the rows.

In is estimated that a seed bed 100 feet long by 5 feet wide, planted with seed in drills 8 inches apart, should give from 5,000 to 6,000 strong seedlings, and these would fill five nursery beds. From these, at least 4,500 plants fit for planting in the field should be obtained.

PLANTING OUT.

The planting season for limes is from June to December, but early planting is to be recommended, for then the plant has time to make satisfactory growth before the dry season commences.

Limes are planted at varying distances apart, according to individual opinion and locality. In some places they are planted as close as 10 feet by 10 feet, or 12 feet by 12 feet, while in rare instances 18 feet by 18 feet, or 20 feet by 20 feet has been practised. Trees planted at wide distances, when mature, give better results than closely planted trees, for owing to the hemispherical shape of the trees they present a greater bearing area, and probably it may be found that a system of planting the trees 10 to 12 feet apart in the rows, and 20 to 25 feet between the rows, would prove successful, and would facilitate many estate operations such as pruning, manuring, etc. Such a system is further to be recommended, since it would allow sufficient space for apparatus used in spraying operations to pass up the rows conveniently, and the fields should be laid out so that the rows might run across the direction of the prevailing wind. The plants thus make, in some degree, a protection for themselves.

The land should be carefully lined at the distances chosen, and holes about 18 inches deep, and from 12 to 15 inches square, should be opened for some time before the lime plants are placed out.

When they are from 18 to 24 inches high, the plants are ready for setting out, and they should be carefully lifted with forks from the nursery beds. The ends of the branches should be cut back 3 or 4 inches, and thus the plants should be placed in bundles or baskets or trays for conveyance to the field. The roots should be watered and kept moist until planted, for good results cannot be expected if the roots are allowed to become dry or exposed. The plants should be carefully placed in the soil at about the same depth as they grew in the nursery beds, and the lateral roots carefully spread out, while the soil in holes around the plants should be moulded up several inches above the level of the surrounding ground in order to ensure that no water should settle around the stems and roots during wet weather.

AFTER-CULTIVATION.

The lime may under favourable conditions commence to give a few fruits in the third year after planting, but experienced lime planters consider that eight to ten years is the time required to bring a lime plantation into full bearing.

If limes are planted among sugar-cane, the canes are, under good management, gradually removed from the land as the lime trees develop. The same course is followed in respect to limes among garden crops, whereas when they are planted in grass or guava bush, or in newly-cleared forest lands, a gradually increased area is cleared around the plants themselves as they develop, and the grass and bush between them are cutlassed occasionally and applied to the soil round the trees as a mulch.

Crops usually grown for green dressings are now being planted in lime plantations, at the time of the first rains, to keep down the weeds during the growing season. They are cut down two or three times during the year to yield a mulch, and early in the dry season should be completely pulled up and used for mulching the lime plants themselves. Of the various green dressings tried, the horse bean (*Canavalia ensiformis*) has proved very useful for growing among young lime trees on the coastal land of Dominica, while in Montserrat the Bengal bean proved of value.

Lime trees require but little pruning, but all suckers and dead branches should

be carefully removed. In consideration of the bare-footed workers on a lime estate, all lime-tree prunings should be burned, and not, as is usual with prunings generally, used for manure.

From the time the young trees are planted, the aim of the planter should be to keep the land in good condition by maintaining and, if possible, increasing the humus in the soil, by the application of pen manure, or by means of frequent bunches of bush and grass from adjoining lands.

Very little is known as to the effect of artificial manures on lime plantations, but too much stress cannot be laid upon the good results that accrue from applications of pen manures or of mulch. The appearance of lime plantations has in a short time completely changed by looking to this operation, and most planters are now alive to the benefits to be derived from attention to the 'humus question.'

The life of a lime plantation has not yet been determined, but in Dominica well-kept fields of limes, planted over thirty years ago, are still in good condition and yield good crops.—*Agricultural News*, Vol. VI, No. 148, 28th December, 1907.

AVOCADO PEARS: PREPARATION AND SHIPMENT.

In *Bulletin No. 14* of the Hawaii Agricultural Experiment Station, a considerable amount of valuable advice as to the best methods of picking, packing, and shipping avocado pears is given to growers who may be thinking of trying to build up an export trade in this line.

The fruit sent in an experimental shipment from Hawaii to the United States was packed in the refrigerator compartments of the vessel, with the exception of a few cases which were carried on the main deck. The packages were on board seven days, this being followed by a two-days' railway journey in hot weather. It will be seen, therefore, that the conditions of shipment were not particularly favourable, but the results of the trial were encouraging, and showed that shipments on a profitable commercial scale were certainly possible.

The writer of the article impresses upon the would-be shippers of avocado pears the importance of great care in packing the fruit. Each fruit must be gathered by hand, and the stem should be cut with a pair of shears, as in the case of oranges. Slight bruises, although not evident at the early stage, are very apparent when the fruit is placed on the market. It is advised that picking should be done, if possible, only on the day the steamer is to leave; certainly not earlier than the evening before. Careful grading of the fruit is very important, as the way in which this operation is done has a great deal to do with the price obtained on the market. If the unusually fine and large pears are put in the same package with average fruits, they not only lose the special price they would command if presented by themselves, but also have the result of making average fruit appear inferior by contrast. Good quality fruit, even of second grade, if neatly packed, should always find a ready market, but, if placed with the best specimens, the value of the whole is lowered.

Avocado pears, it is advised, should not be packed in boxes of too large a size. The size of crate recommended as being likely to give satisfactory results for medium-sized fruits is of the following dimensions:—13 × 14 × 3¾ inches inside measurement. Such a crate would hold about one dozen pears. It will be seen that boxes of this depth allow of only a single layer of fruits. For large sized avocados, the depth must be increased to at least 4 inches. In packing, it is recommended that, as with oranges intended for export, each fruit should be wrapped in a piece of paper just large enough to make a single cover. Over 160 pears, with nothing but a single paper wrapping, arrived at Portland, Oregan, from Hawaii, with a loss of only 2·9 per cent. Fruits packed more elaborately, *e.g.*, in individual compartments, provided by the use of corrugated straw boards, were in no better condition on arriving at their destination. In placing the individual pears in the boxes, jarring is only prevented by packing them as close together as possible, although it is not advisable to induce any pressure.

The provision of holes in the sides of the boxes and the spacing between the boards forming the cover, ensure a suitable ventilation of the fruit. A narrow piece of wood, too, is nailed along two opposite edges at the top of each box. By this means the passage of a current of air between each box and the one above it, is made possible. The most suitable temperature for storage of avocado pears, it is said, is not yet definitely decided. Prolonged storage in the refrigerator compartment, however, is mentioned as resulting in the blackening of the interior of the avocado. It is recommended, as a result of observations made, that the temperature should not be allowed to fall below 40 °F. The refrigerator room in the ship should be cooled as rapidly as possible so as to lower the temperature of the fruit, and a uni-

form temperature should be maintained throughout the voyage.—*Agricultural News*, Vol. VI, December 28, 1907. No. 148.

THE INDUSTRIAL PROSPECTS OF CASSAVA STARCH.

Although cassava has been grown in Jamaica from the earliest days of which any record is obtainable, it is only recently that its commanding merits as a source of high-class starch have attracted the attention of practical men.

It is now admitted that cassava starch has certain qualities that make it of exceptional utility in the dressing of cotton goods, and there is also reason to believe that the quality of the cassava starch producible in Jamaica is superior to that obtained from the same plant grown in the East Indies.

When this industry first attracted attention in 1903, principally through the efforts of Mr. J. W. Middleton, the greatest uncertainty existed as to the yields of tubers obtainable per acre and to the content of starch to be expected under the conditions obtaining in Jamaica.

The Chemical Department, therefore, undertook a study of this matter, and during the past three years a good deal of information has been obtained.

Starch manufacture has since been started at three centres in Clarendon, St. Ann, and St. Catherine, and we are already in sight of definite commercial results with the new industry.

The pioneers, as in all new undertakings, gain experience in a somewhat expensive school, and much work and ingenuity are still required before the industry can be placed on a sound and economical basis. The prospects are, however, most promising, and it is now quite possible to state that the cassava starch industry in Jamaica offers an attractive investment of capital.

YIELD OF TUBERS.

The results of the tests of twenty-one native varieties of cassava at Hope indicate that under the conditions of a moderate rainfall and a friable soil, very large yields of tubers are obtainable. At twelve months, a maximum yield of 10½ tons rising to 15½ tons at fifteen months and of nearly 22 tons of tubers per acre at twenty-one months has been recorded.

It is true that we could not expect to reap from 100 acres at the rate obtainable from a small plot of $\frac{1}{10}$ acre, and that on a large scale these enormous yields could hardly be expected as an average. At the same time, these results indicate that a return of 10 tons of tubers per acre should not be a difficult matter to realize under good cultivation. The indicated yield of starch per acre rose from 3½ tons at twelve months to 5½ tons at fifteen months, and over 7 tons of starch per acre at twenty-one months' growth in these trials.

As a starch producer, the cassava should therefore take the highest place among the economic plants of the world.

MATURATION AND VARIETIES.

Of the twenty-one local varieties of cassava tested in our experiments, two or three stood out as particularly prolific. Our experience of cassava varieties grown in Jamaica points very strongly to the necessity of planters testing all the best kinds themselves, as the greatest variations appear to exist in the behaviour of the same variety of cassava under different conditions of soil and climate.

As a rule, the variety grown by the local peasantry will be found to be one well suited to the district, and any planter commencing the cultivation of cassava on a large scale would do well to study very closely the practices of the small settlers in his district.

He would then learn that it was necessary to secure perfect drainage in the soil zone in which the tubers are produced, and would avoid the serious mistake of planting cassava on stiff soil on the flat, without any drainage at all. Serious losses of tubers have already occurred on some large cultivations through the neglect of this first principal of cassava cultivation. The resurrection of a Jamaica Carib of the pre-Columbian days would undoubtedly serve to give the cassava planter of to-day useful advice as to the successful cultivation of a crop that was formerly grown all over the island.

At Hope, the best variety for harvesting at twelve months' growth was found in the local cassava grown in the district, and known as 'white top.' This gave 10½ tons of tubers, containing nearly 4 tons of starch, per acre.

It would appear that in Jamaica a long period of growth is the most economical basis for cassava cultivation, and that quick returns and early maturing varieties do not afford such a prospect of profit as the larger yields of varieties of longer growth. The variety 'long leaf blue bud,' was found superior to the 'white top' when allowed to grow for fifteen months, yielding 15 tons of tubers, containing 5 tons of starch, per acre, while at twenty-one months

growth, the lead was taken by 'blue top' which gave the enormous return of 21·9 tons of tubers, containing over 7 tons of starch, per acre.

These results indicate that in the Liguanea Plain, it would be advisable for a starch factory to put in half its area in 'white top,' for quick returns, and the remainder in 'blue top' grown as a biennial.

It has still to be ascertained whether the practice in the East Indies of harvesting the mature tubers without destroying the plant, and leaving the small ones to grow on, is suitable for large-scale cultivation in Jamaica. In friable soil where the tubers are readily accessible, the treatment of the cassava plant as a perennial on this basis might prove to be sound practice. The chief omen against the success of this method is that it would most certainly have established itself to be the custom of the country, had it been from objection ; since many generations of estate cultivators, inspired by the genius of the empty stomach, have been growing cassava in this island, and it is certain that this must have been well tested in previous ages.

COST OF PRODUCTION OF TUBERS.

The cost of growing cassava on a large scale in Jamaica has been studied by Messrs. J. W. Middleton, Joseph Shore, the Hon. H. Cork, the Hon. J. V. Calder, and at the Hope Experiment Station. It has been deduced from the figures put forward, that cassava should cost, for cultivation only, from £3 13s. to £5 per acre, according to locality and circumstances.

The lower price represents the estimated cost under the most favourable conditions of broad-scale implemental culture on friable soils, while the higher price would be the cost of cassava farming on rocky land by hand labour.

An average cost of £4 per acre represents the estimated cost under favourable conditions of estate cultivation.

The Hon. Henry Cork has estimated that a capital of £1,600 to £2,000 would be required for starting a cultivation of 100 acres of cassava on new land. Allowing 10 per cent. on capital and 20 per cent. on live and dead stock account, Mr. Cork's estimate sets the actual cost of such a cultivation at £6 to £8 per acre. With regard to the yield of tubers to be expected, it would appear that an 8-ton crop should be a fair average, while good lands with efficient tillage should return 10 tons and more per acre. These figures indicate that cassava can be grown in Jamaica at less than £1 per ton.

Should cassava farming be started, it would be desirable for the purchasing factory to pay on the starch value of the tubers. We have found from experimental trials that the specific gravity of cassava tubers bears a definite relation to the percentage of starch they contain, and that it is possible approximately to ascertain the starch value of cassava tubers by means of the potato balance, used on the Continent. A table is being prepared, giving the approximate starch content corresponding to the readings of the cassava balance, which should be useful to buyers of cassava in arriving at a fair price for the purchase of cassava tubers from contributary growers.

MANUFACTURE.

Much has still to be worked out as to the most efficient plan for dealing with the cassava grown in Jamaica, for the manufacture of starch, cassaripe, and cattle food. The first process is that of washing and decorticating the tubers. For this purpose the simple machine recently devised by the Hon. T. H. Sharp, which I have seen at work at Eltham Park, appears to be entirely satisfactory.

The great cost of peeling tubers by hand in the early experiments is thus entirely avoided, and the tubers are automatically washed and delivered free of the cortex by the operations of this machine. This invention has solved one of the outstanding difficulties that faced the starch producer in Jamaica.

To secure an efficient recovery of starch, the finest possible disintegration of the cut-tissues of the cassava is necessary. There are mills now obtainable that give excellent results and produce a very fine disintegration at a high rate of production.

A second grinding or disintegration should be carried out where starch is the main object of manufacture, but where a good market can be found for the dried residue as a cattle food, the second milling may probably be disregarded.

The sieving, purification, settling, refining, and drying of the starch seem all to be capable of easy accomplishment with suitable machinery, and there is now no doubt at all, that a starch factory to produce 1,000 tons of starch a year could be erected with every certainty of producing a high grade of cassava starch. Such a factory should not cost more than £6,000 or £7,000 to erect, and, with intelligent management, a satisfactory result should be assured.

COMMERCIAL VALUE OF CASSAVA STARCH.

It would appear that a well-made cassava starch is worth £14 to £16 per ton in the English market. A contract for a large quantity of cassava starch at the latter price has been secured by a planter in the West Indies, and sales of cassava starch from Jamaica have recently been made at £14 per ton c.i.f. At such prices as these there is a liberal margin for meeting those contingencies of industrial operations in the West Indies for which it is impossible to make allowance, and on account of which many a project has proved a failure, when the apparent margin is too limited.

The 'bitty,' when dried, is a valuable cattle food. A sample from the Longville factory was found to contain 65·7 per cent. of carbohydrates on a basis of 15 per cent. of moisture, and should find a ready sale at 50s. to 60s. per ton. A planter from Dominica recently informed me that he had found a good market for cassaripe in England, and it is possible that this article may become a useful by-product in the manufacture of cassava starch. We in Jamaica have so far been unable to find a market for this product in the United Kingdom, and if a demand should arise it could be produced in large quantities here.

CONCLUSION.

Cassava is a plant that has survived from the earliest occupation of the island by mankind, and is capable of yielding returns of starch under suitable conditions. These encouraging facts place it ahead of any other plant grown for the purpose of starch production.

Further, the intrinsic qualities of cassava starches producible in Jamaica are of a high order, and a well-made article can command a high price.

It would appear that this industry offers a field for investment and development whereby large areas of land, at present of small productive power, could be made to yield a handsome profit.—*West Indian Bulletin*, Vol. VIII, No. 3.

LETTUCE CULTURE.

BY C. F. AUSTIN AND E. W. HALSTEAD,
Chief and First Assistant of the Department of Horticulture of the Estación Central Agronómica, Cuba.

The origin of cultivated lettuce (*Lactuca sativa*, Linn.) is unknown, but it is supposed to have originated from *Lactuca scariola*, Linn. in Asia. This popular salad vegetable has been under cultivation for more than 2,000 years. Lettuce is a quick-growing annual; it delights in a cool temperature and moist open soil. The forcing of lettuce under glass has become a very prominent industry in the northern half of the United States and many other countries having a similar temperature. One can gain some idea of the lettuce industry, as statistics show that California alone grows over five hundred acres each year for seed. This area produces over 250,000 pounds of seed annually. Large areas of lettuce are grown each year along the southern seacoast from Florida to Texas for shipment to northern cities. The cultivation of this vegetable is extending rapidly in this region, for nice lettuce can be grown out of doors and shipped for less money than it costs to grow it under glass.

We have experimented with over forty varieties during the past year, and it is our purpose to call attention to this important garden crop in the following pages. Lettuce grows so successfully here that there is no reason why every person who has a garden spot should not have an abundance every month in the year, though it grows best from October to May.

GROWING OF PLANTS.—The soil in the seed-bed should be made very fine, loose, and mellow for the seed is small and very light. It should be sown rather thickly across the bed in rows from two to three inches wide and from one-fourth to one-half inch deep; cover the seeds lightly and press the soil down firmly over them. They should germinate and be coming up in from five to eight days. One to one and one-half ounces of seed will give plants enough to set one acre. As soon as the plants have the first rough leaves started they should be transplanted into another bed. In transplanting it is best to have the rows four inches wide and the plants two inches apart in the row. They are left in this bed until ready to set in the field or in permanent beds. The seed-beds should have plenty of humus or well-rotted stable manure thoroughly mixed with the soil. When the young plants are first transplanted they should be shaded from the sun for a few days. It will usually be from two to three weeks from the time the plants are first transplanted until they are ready to set in the field, or about five weeks from the sowing of the seed. The plants should be large and strong when set in the field, having from four to six well-formed leaves. For the construction of seed-beds see Circircular No. 11.

SOIL.—Lettuce is a very cosmopolitan plant as to soil; for home use almost

any character of land will answer, but for commercial plantings the soil should be fine and mellow.

The more quickly lettuce can be grown under reasonable conditions the better; for the deliciousness of this vegetable lies in its crispness, sweetness, and tenderness. To grow lettuce quickly the soil should be moist and exceedingly well supplied with vegetable matter. If this does not occur naturally in the soil, it should be supplied by a good top dressing of well-rotted stable manure thoroughly worked in. The land should be plowed from five to six inches deep and then harrowed until the surface is smooth and mellow. All kinds of rubbish in the form of clods, stones, grass, etc., which might cover up the young plants during cultivation, should be removed.

For family use only a few short rows will be needed in the home garden. To give space for cultivating with a horse, the distance between the rows should be from two to two and one-half feet; the plants should be from ten to twelve inches apart in the row. Where all of the work is to be done by hand, the rows should be laid off in checks from twelve to fifteen inches each way. A plant should be set in each of these checks. In setting plants a dibber or the forefinger should be used. The roots should be pressed into the soil which should then be brought well up around the stem of the plant and made firm and solid. If the ground is dry at setting time, give a thorough watering, and, as soon as the water has soaked away, hoe some loose fine earth up around each plant. In this country, where the sun is so hot during the middle of the day, it is well to shade the plants with a little loose dry grass for a few days until they have taken root.

Fertilization.—Along with the stable manure a liberal application of commercial fertilizer should be given to most soils. Apply the fertilizer broadcast over the whole surface where hand cultivation is to be given. This should be done several days before the plants are to be set and the fertilizer should be thoroughly harrowed into the soil. When plants are set in rows two feet or more apart the fertilizer should be applied in the rows ten days or two weeks before the planting time. A very good way is to open the row with a single shovel plow and then drill in the fertilizer, which should be mixed with the soil by going back and forth in the row with the plow once or twice. The furrow is then plowed full so as to have the surface smooth and level for setting the plants.

We have used with good results a fertilizer mixed by weight as follows.

Sulphate of ammonia	...	2 parts.
Sulphate of potash	...	1 ,,
Acid phosphate	...	3 ,,

This mixture, applied at the rate of eight hundred to fifteen hundred pounds per acre according to the natural fertility of the soil, ought to give good results.

Cultivation and Irrigation.—As soon as the plants have been set a day or two, they should be cultivated and hoed. For hand cultivation the cultivator and its attachments (illustrated in Fig. 1) will be found very useful. For working such small plants with a horse, the cultivator (seen in Fig. 2) is the best one to use. This style of cultivator has from 12 to 16 teeth, and is so arranged that it can be used in narrow rows and close to small plants. The teeth are very small and narrow, and so made as not to throw a furrow of any size. There is nothing which helps the growing of young plants so much as to keep the surface of the ground carefully, frequently, and thoroughly stirred.

Like any other garden crop, lettuce should not be watered except when water is needed, and then the ground should be thoroughly soaked. This crop must be kept growing if the product is to be tender and crisp. Cultivate and hoe carefully after every rain or irrigation so as to prevent the soil from baking and to keep a coating of fine loose soil over the surface of the field. The frequency of irrigation will depend upon the character of the soil, conditions of climate, frequency of cultivation, etc. For a more complete discussion of irrigation and dust mulch, read *Bulletin No. 4 on Tomato Culture.*

Shade for Lettuce.—The frame of the tobacco tent at the Estacion Agronomica was so constructed as to leave a slanting edge around the whole circumference. When the frame was covered with cheese cloth the strip of land under this slanting edge was about eight feet wide. The distance from the ground to the cloth varied from three feet at the outer edge to eight feet, the height of the frame, at the inner edge. As this height was not enough for tobacco planting, arrangements were made with the Agricultural Section to use the strip for an experiment with lettuce under shade. When the tobacco frame is covered with cloth no air enters except what passes through the cloth.

The ground was laid out into beds and all were fetilized alike. Each bed contained fifty plants, and in all fifteen varieties of lettuce were planted. The date was Dec. 5, 1904. At the same time

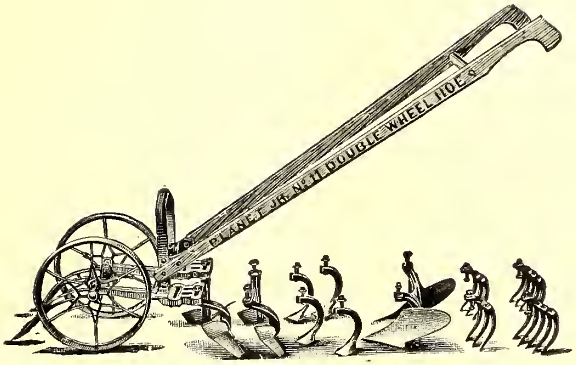

FIG. 1.—A HAND CULTIVATOR.

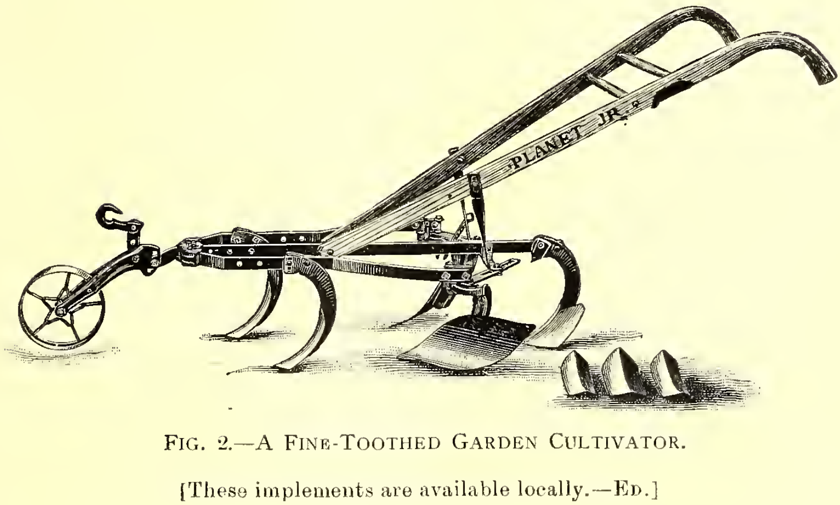

FIG. 2.—A FINE-TOOTHED GARDEN CULTIVATOR.

[These implements are available locally.—ED.]

that the plants were set in the tobacco house, the same varieties were planted in the open field. On January 19, 1905, the beds were examined and the following results were noted. On the east and south of the frame, where the plants were exposed to the direct rays of the sun for more than half of each day, the rows of plants next to the outer side of the frame, or where there was only from three to four feet of space between the ground and the cloth, were the poorest. There was a very marked difference between these plants and the ones grown where the distance from the ground to the cloth was from seven to eight feet. A marked graduation in the size of the plants was very noticeable, the largest heads being where the distance from the ground to the cloth was the greatest, and the rows becoming smaller and poorer as they approached outside of the bed. The plants along the north side, where there was a more uniform effect of the sun, were practically all of the same size.

The results as to the yield of good heads and as to quality were no better and with many varieties not so good as in the case of the plants grown in the open field.

The results showed very clearly that conditions under tobacco cloth are not suitable for lettuce culture. The lettuce under shade produced a larger percentage of poor soft heads. There was also a tendency for the heads to run to seed more quickly than when in the open field. The rot (*Botrytis vulgaris*, Fr.) was much more marked than in field-grown plants.

HARVESTING AND PACKING.—Lettuce for market should not be cut until the heads are fully grown, whether it is of the loose or the cabbage-headed varieties. The loose-headed sorts may be used for the home table as soon as the leaves become large enough to cut. With the cabbage-headed varieties it is very different, and they are not ready to cut until the heads become firm and solid. The inner leaves should be well blanched so as to be tender and crisp. In cutting lettuce it should be handled very carefully so as not to break or tear the leaves any more than is possible. As soon as it is cut it should be taken to the packing house so as to prevent wilting from the sun.

It is a good plan to sort the heads according to size and firmness. Each head should be carefully washed and the outer leaves that are soiled should be removed.

There is no standard package to be used, but for local markets or short distance shipments some form of cheap basket holding from five to eight dozen heads is the most common. For long distance shipment a large crate or a barrel is usually used. A central partition is usually put into a large package so as to relieve the weight. In packing, the outer leaves should be wrapped up around the head so as to afford as much protection to the inner part as possible. Place the heads carefully but very firmly in the package, so that they will shift as little as possible in transit. It is very difficult to pack lettuce so that it will carry well, as it is so loose and spongy that unless great care is taken it will arrive on the market in poor shape.

TEST OF VARIETIES.—During the past season forty-three varieties were tested. Many of the varieties have done exceedingly well here, some very fine lettuce having been grown in our beds.

For type standards and descriptions we have followed the work as outlined in *American Varieties of Lettuce* by W. W. Tracy, Jr., Bulletin 69, U. S. Department of Agriculture, Bureau of Plant Industry.

TYPES AND THEIR VARIETIES RECOMMENDED FOR PLANTING IN THE HOME GARDEN.

Butter Type, cabbage-heading.
- Big Boston.
- Cold Frame White Cabbage.
- California Cream Butter.
- Tennis Ball Black-seeded.

Butter Type, Bunching.
- Oak Leaf.

Crisp Type, Cabbage-Heading.
- Deacon.
- Iceberg.
- Mignonette.
- New York.

Crisp Type, Bunching.
- Black-seeded Simpson.
- White Star.

Cos Type, Self-closing.
- Dwarf White Heart Cos.
- Paris White Cos.

For commercial purposes the following varieties are the best: Hubbard Market, Big Boston, California Cream Butter, Tennis Ball Black-seeded, Deacon, Iceberg, and New York.—*Estacion Central Agronomica de Cuba, Bulletin* No. 8, Sept. 1907.

BRITISH GUIANA RICE INDUSTRY.

In a report of an interview with Sir Daniel Morris on November 16 last, the Demerara *Argosy* publishes the following remarks made by the Imperial Commissioner with reference to the rapidly extending rice industry of British Guiana :—

During my visit to Canada, said Sir Daniel Morris, in order to impress the people of the Dominion with the resources and possibilities of the West Indies and British Guiana, I cited the remarkable development of two new industries which had been called into being practically during the last five years.

One was the Sea Island cotton industry, started at St. Vincent, Barbados, and the Northern Islands in 1903, and which is now of the annual value of nearly quarter of a million sterling, or $1,200,000. This Sea Island cotton is still capable of further development, and the fine spinners of Lancashire are satisfied that they can look to the West Indies for their supply of this particular class of raw material. The other development to which I drew attention was the singularly interesting one of rice growing in British Guiana. This has been called into existence on a commercial scale within the short period of eight years. The yield of rice in 1899 was under 5,000 tons; in 1902 it had increased to nearly 16,000 tons, and according to the returns published by the Government last year, it had reached a total of 30,000 tons.

In addition to rice, the colony can look forward to a considerable extension of the lime, coconut, cacao, and rubber cultivations, so that these subsidiary industries may ensure the continued well-being and prosperity of the colony. From the returns of the rice industry it would appear that whilst seven years ago the imports into British Guiana were a little over 25,000,000 lbs., last year they had fallen to 6,000,000 lbs., showing that during a comparatively short period the imports had shrunk more than 75 per cent. It is gratifying to learn that though a considerable revenue may have been lost by the falling away in the imports of rice, this has been practically made up by the larger imports of dry goods and other commodities.

British Guiana has arrived at the position that while enormous quantities of rice are being produced locally, which are taking the place of grain formerly imported, it has also begun to export rice to the neighbouring colonies in the British West Indies, and to French and Dutch Guiana. As far as I am able to gather, the first rice exported from British Guiana amounted to 10,506 lbs. in 1902-3; this was of the value of $290. In 1904-5 the exports reached 61,225 lbs., of the value of $1,709, while last year the increase was considerable, the exports amounting to 3,474,512 lbs., of the value of $89,078 (£18,000).

It would appear from a question asked at the address delivered by me on Friday, that some of the growers are concerned as to the best means of disposing of rice straw. It is true that rice straw is capable of being made into paper; on the other hand, if it is to be shipped out of the colony, it will have to be pressed into compact bales and the freight would be considerable as compared with the intrinsic value of the material. It would not be a difficult matter to send sample bales of rice straw from British Guiana to be tested and reported upon by paper makers in Europe or in Canada. In the meantime, the Board of Agriculture would do valuable service if it could persuade the small growers to use the rice straw as fodder and bedding material for their animals, and return the straw in the form of manure to the land. It is a terrible waste of good manure to burn the straw, as I understand some of the small growers are doing at present. It is absolutely necessary for lands under cultivation to receive back a proportion of the vegetable material taken from them; otherwise they lose their fertility. Rice straw might also be utilized as a mulching material in all kinds of cultivation. It would keep land in good condition during prolonged periods of drought, and it would also keep down weeds and maintain for long periods the productivity of areas under cultivation in limes, cacao, rubber, and fruit trees, without the use of artificial manures.—*Agricultural News*, Vol. VI., No. 148, 28th December, 1907.

REPORT ON THE RICE INDUSTRY IN THE UNITED STATES.

BY MR. E. SEYMOUR BELL,

British Commercial Agent in the U. S.

(Concluded.)

PROGRESS OF CULTIVATION.—It is said that the first growers of rice in Louisiana and Texas were the Acadians, French settlers of Nova Scotia.

Judging by the returns, early rice growing in Louisiana offered little attraction for that capital which, in recent years, has developed so much of the land not formerly cultivated by the Acadians, but adjacent to their little fields, and which were believed by them to be almost valueless. Their methods

of cultivation were primitive, the acreage planted was small and the harvesting was done by hand. Such success as they had, however, convinced later settlers that the business of rice growing could be made profitable. It soon became apparent that it would not do to depend on the rainfall for the irrigation, and steps were taken to prevent the heavy rainfalls from running to waste by damming the water back in the fields. This was the beginning of artificial irrigation. Owing to the imperfect drainage of the lower lands harvesting continued to be done with the sickle. Threshing was done with the flail, and winnowing was dependent upon the breezes. It was only in 1894 that pumping on a large scale was commenced. It had been found that the higher lands were well adapted for rice culture if sufficient water could be procured. It was then that the centrifugal pump was first employed, and canals were constructed to carry the water to the fields.

The effect of successful irrigation on the prairie lands was a rise in value of such lands. In 1888 these lands could be obtained at from 1 dol to 3 dol. 50 c. per acre, according to their facility for cultivation. In 1892, when pumping experiments were being carried out, the value rose to 7 and 10 dol. per acre, and in 1895 the value reached 15 and 20 dol. per acre. Some of these same lands are now held at an average price of 30 dol., and a few choice locations bring as much as 50 dol. per acre. Rice lands not so favourably situated as regards canals may still be had for 15 dol. per acre, but considerable capital is required to provide canals and pumping plants.

The following is a comparison of the value of rice land with wheat lands in various States :—

		Average Value per Acre.	
		$	c.
Rice, coast country	...	20	0
Wheat— ...	...		
Indiana ...	...	3	71
Illinois ...	...	8	32
Iowa ...	...	9	20
Kansas ...	...	9	73
Missouri ...	...	7	88

The rice belt is intersected by ten navigable rivers and by many smaller streams, all conveying fresh, soft water comparatively free from slit.

In nearly every township there are one or more ridges slightly above the surrounding land. On these ridges surface canals were built from 20 to 150 feet wide, according to the area to be watered. The sides of the canals were raised from 4 to 5 feet with ploughs and scrapers, or with grading machinery. Laterals were run from the main canal to accommodate remote farms. Powerful pumping machinery was located on the banks of the river at the head of the surface canals. These canals, when well constructed and operated, proved entriely successful and made the rice crop a practical certainty over a large section of the country.

UNDERGROUND WATER SUPPLY.—Scarcely had the surface canals been accepted as a success when it was discovered that there was a strata of gravel at 125 to 200 feet under the surface of the entire section of south-west Louisiana containing an unlimited supply of water which would, of its own pressure, come so near the surface that it could be easily pumped. It was afterwards discovered that this bed of gravel was nearly 15 feet in thickness.

Throughout the entire belt the surface has such a slight variation that for the purposes of irrigation it may be considered practically level. The soil is rich, sandy loam, in some sections underlaid with tenacious clay at the depth of 2 to 3 feet. In the other sections the soil is a strong clay or clay loam, with subsoil conditions similar to that of sandy loam. Between these extremes the sand and the clay form many grades of loams, but all easily tilled and fertile. At a depth of 8 to 16 feet from the surface a stratum of water-bearing sand is generally struck, the water answering for domestic purposes.

Pipes of 2, 3, 4, 6, 8 and 10 inches in diameter have been sunk to the gravel and pumped continuously for months without diminution of supply. The water is soft, at a constant temperature of 70°, and absolutely free from all seeds and injurious minerals. Such is the facility with which these wells are made that a 6-inch tube has been put down to the full depth required—200 feet—in 14 hours.

Most of the later wells are 8 and 10 inches in diameter. The California propeller pump seems to excel the centrifugal in popularity. Sets of four and five wells have been bored, worked by one 50 horse-power engine, and will irrigate from 500 to 1,000 acres.

The cost of wells in south-east Texas is about as follows :—10-inch well complete, 200 feet deep, 650 dollars; California propeller pump in place in well, 250 dollars; 20 horse-power engine, 700 dollars; total for plant, 1,600 dollars. This should water 250 acres of rice land for sixty days at a total cost for fuel, oil and engines of 400 dollars.

Elevating water to the upland prairies will always be an expensive undertaking, but the farmer who has successfully grown wheat or oats has no difficulty in undertaking the farming of rice. The process, except for the irrigation, is practically the same.

Cultivation in Texas.—The land is ploughed with gang ploughs in the autumn or spring, sometimes both, then disced and harrowed thoroughly. Planting is done with the broadcast machine attached to an ordinary farm wagon, or the seed is drilled in rows from 7 to 8 inches apart, the latter method insuring a better crop. During the planting season, which extends from April 1 to June 15, or later, no water is put upon the land, dependence being placed upon rainfall to sprout the seed and promote the growth of the plant for a period varying between one and two months, depending upon the season and water supply. Flooding usually begins when the rice reaches a height varying between 6 and 10 inches, and from this time on until the grain is in the milk and well formed, a period of about 70 days, the fields are kept flooded.

About ten days before harvest the fields are drained. The grain rapidly hardens and matures, and by the time it is ready to cut, the field is sufficiently dry to permit the use of the reaper and binder. This machine is identical with that used in the grain fields elsewhere in the United States. The sheaves of rice are shocked in the field immediately after the binder, ten sheaves to the shock being the rule, in order that there may be a free circulation of air to dry the straw. When harvesting begins the stalks and leaves of the rice are still green, in the main, but the head is golden yellow on the terminal two-thirds. The green straw, properly cured, is a valuable substitute for hay, and is baled and fed to live-stock, including the work horses and mules, which become accustomed to it, often preferring it to prairie hay. Harvesting begins in September, and continues through October and part of November, often until December 1, and threshing the rice from the shock begins after it has been allowed to cure and dry for a period of two weeks at least. The machines used are the modern styles of wheat threshers using steam power, revolving knives for cutting the binding twine, and a blower to remove and stack the straw. The rough rice, as it comes from the thresher, is put in large gunny sacks weighing, when filled, an average of 185 lbs. each. The sacked rice is either hauled to the warehouse or direct to the mills

The cost of raising a crop of rice in Texas on 100 acres of land is estimated as follows:—

	Cost. Dollars.
Ploughing at 1 dollar per acre ...	100
Seed for same, one sack (or about 3½ bushels) for 3 acres ...	100
Seeding with drill	50
Watching levees (one big boy for three months)	30
Cost of water (this refers to canals)	300
Cost of harvesting 100 acres at 2 dollars per acre	200
Cost of 1,000 sacks	75
Cost of threshing 1,000 sacks at 10 cents per sack	100
Interest upon the value of land improvements valued at 4,000 dollars, at 6 per cent ...	240
Total...	1,195
Estimating the yield at 10 sacks per acre and sold for 3 dollars per sack would give ...	3,000
Leaves a net profit of ...	1,805

Rice Production.—The evolution of rice milling has been as great as the production.

Many things are yet to be learned, about rice in connection with machine production. As yet it does not take as high a polish as hand produced rice. It has what is known as a chalky edge, which reduces the price of the finished product 50 cents per 100 lbs. The price of rice at present is based on the amount of shine it takes, and not what it is. The chalky edge is due to careless management in producing large crops, and will soon be remedied. Another thing to be learned is better cultivation, as necessary to quantity and quality of the product.

Properly harvested and marketed, rough rice brings from 2 to 5 dollars per barrel, depending upon general prices, grade, &c.

Rice is considered one of the surest crops raised, there is no probability of drought when the water supply is attended to, and it is little injured by excess of rain. With good cultivation and care rice yields 15 barrels (60 bushels) per acre. It has been known to yield as much as 30 barrels to the acre.

100 acres of rice furnish at least 100 tons of straw superior to native prairie hay, and 25 tons of bran and polish. This provides for the wintering of 100 head of stock.

Rice stubble is used for fattening swine, cattle and horses.

The Louisiana experiment station collected the opinions of a number of the most prominent rice growers, who agreed in the main on the following methods :—The land is broken with four-mule gang ploughs, reaching about 3 inches. Disc and spring-tooth harrows are used, and, when necessary, complete pulverisation is secured by the use of a smoothing harrow. Should the ground be too hard, water is turned on to soften it. The growth is found more uniform where a drill is used, although the rice may be sown broadcast. In moist, warm weather water is not turned on for from four to six weeks, and then care is taken not to cover the tops. An average season requires three months' flooding. The water is withdrawn from the field when the heads begin to turn and the rice is passing into the "dough stage." This is usually from 10 to 14 days before harvest begins.

Three horses with a modern self-binder will harvest from 5 to 12 acres daily. The same thresher used for oats will thresh rice. Where the farmer supplies the hands the thresher usually charges 2½ c. per bushel. In threshing from the shock something like seventeen men are required.

IRRIGATION CONTROL.—The part played by water being of importance where irrigation is necessary, the following description of the arrangement at a certain station may be of interest :—

The instruments used to regulate the flow of water were placed upon a small tract containing 37·96 acres of land. The middle branch of the main canal, 80 feet wide at the point of diversion, was tapped by a small flume 2½ feet wide and 40 feet 6 inches long. The levee, which is 3½ feet high, was cut and aprons of sheet piling driven through the levee and into the virgin soil. These aprons furnished ample provision against leakage and wash at the sides of the flume. A standard water register was used to keep a continuous record of the depth of the water passing through the flume and the times when water was applied to the rice.

The evaporating tank was established in such a manner as would reproduce conditions which prevailed in the rice field. It was set in a pit and partly filled with soil. Water was poured in until its level was about 4 inches above the surface of the soil. About one foot above the water surface in the tank a light wire netting was placed horizontally, being stretched over a square frame which rested upon posts at the corners. The wire screen was used as a support for grasses and rice straw, which were increased in quantity as the rice matured in the field, so that the depth of shade cast over the water by the growing rice was reproduced, as nearly as possible, in the tank. There is no question whatever that the evaporation from a tank placed upon the top of the ground, and exposed to the direct rays of the sun would be far greater than that shown in this experiment.

The raingauge was a double tube securely mounted upon a post, the top of the gauge being about 4 feet above the ground.

By the means above described, a record of the evaporation, the rainfall and the times when irrigation took place was kept. From the continuous record of the depth of water which passed through the flume kept by the register the volume of water used on the rice-field was determined. These records covered a period of 71 days. During this period the experiment field containing 37·96 acres of rice received from the canal enough water to cover it to a depth of 19·66 inches, and enough rainfall to cover it to a depth of 9·15 inches. The evaporation during the same period was 16·03 inches, leaving a net depth of water to promote the growth of the rice crop and supply the volume taken up by the soil amounting to 12·78 inches. The following table shows the water received by the crop during the several weeks of the irrigating season :—

	Flood Water.	Rain-fall.	Evapor-ation.
	Inches.	Inches.	Inches.
Week ending—			
June 29 ...	3·42	0·42	1·90
July 6 ...	0·47	0·66	3·36
„ 13 ..	8·10	0·36	2·04
„ 20 ..	2·39	2·16	0·12
„ 27 ...	0·30	1·56	1·20
August 3 ...	0·58	2·70	1·10
„ 10 ...	0·96	0·96	3·24
„ 17 ...	3·19	...	1·20
„ 24 ...	0·20	0·30	1·08
„ 31 ...	0·05	0·03	0·79
Total ...	19·96	9·15	16·03

SUMMARY.

Area irrigated	Acres	37·96
Depth of water received from irrigation ...	inches	19·66
Depth of rainfall ...	„	9·15
Total depth of water received by the land ...	„	28·81
Evaporation	„	16·03
New depth of water received by the land ...	„	12·78

DISTRIBUTION OF WATER.—The method employed in the rice district to distribute water from the large canals has proved fairly satisfactory. A superintendent of distribution is employed by each large plant, and the duties of this officer are defined by his employers. The superintendent has personal supervision and ostensible control of the headgates through which water is drawn from the main canal. Under him are a number of assistants, usually one for every 2,500 or 3,000 acres irrigated. These assistants walk the levees and keep them intact. Weak places are watched closely and breaks promptly repaired. The assistants also keep a watchful eye upon the growing rice, and especially upon the fall of the water in the fields and report when, in their judgment, additional water is needed. When such a call for water is made, the superintendent, by order or in person, opens the proper headgate and allows sufficient water to flow out and then closes the gate. His assistant attends to the distribution of the water, seeing that the cuts are properly covered and that the supply furnished is economically used. This is the system of water distribution both in Louisiana and Texas, and during favourable seasons, it must be admitted, has worked with a fair degree of satisfaction. The fact that water is not sold for cash anywhere in the rice district, but is furnished for one-fifth of the crop, whatever that crop may be, greatly encourages co-operation between the parties interested. The companies which supply water have almost as great an interest in securing as large a crop as possible from every acre of land irrigated as the tenant who owns neither land nor water, but depends for a living wholly upon the crop he raises.

LEGISLATION IN LOUISIANA.—The irrigation industry in the rice districts is confronted with the question of the control and division of the water supplies. Since the industry is comparatively new to Louisiana, this question has received but little consideration there. The industry has developed so rapidly during the past decade, however, that millions of gallons of water are being drawn from the streams of this State every minute during a third of the year, and it is believed that it will add to the stability of the rice-growing industry if water rights can be placed on a firm foundation.

An examination of the constitution of Louisiana reveals only one article bearing on the subject of water titles. This article declares "Riparian owners of property on navigable rivers, lakes or streams within any city or town in this State having a population in excess of 5,000 shall have the right to erect and maintain on the banks owned by them such wharves, buildings and improvements as may be required for the purposes of commerce and navigation subject to certain conditions."

The statutes of the State contain brief mention of the appropriation of water for agricultural purposes. One section provides redress against the consumer of water for irrigation who neglects to meet his obligation to the canal owner for the supply furnished. The words of the statute are as follows:—"Any person, association of persons or corporation who shall furnish water to another for the purpose of aiding or assisting him in the growing or maturing of a crop shall have the privilege co-equal with the privilege for supplies upon said crop to secure the payment of the agreed compensation therefor."

At the same time the Legislature provided for taxing the rice growers, and at the session of 1900 the rice growers of the upland prairies received protection from unlawful diversion, and the canal owners from interference with the headgates by water users, by the provisions of the following section:—"Any person who shall knowingly or willfully cut, dig, break down, open, close or dam any canal, ditch, intake, flume or levee, the property of another, for the purpose of irrigation or drainage, with the intent to maliciously injure any person, association of persons or corporation for his own use or advantage, unlawfully and without permission, with intent of stealing, taking or causing water to run or pour out of such canal, ditch, flume or levee, and applying the same to his own or other's advantage or to the injury of others, or by constructing a dam or other obstruction in a canal, ditch or intake so as to prevent or interfere with the use of water by others, he, she or they so offending shall be deemed guilty of a misdemeanour, and on conviction thereof shall be fined in a sum not less than 50 dollars, nor more than 500 dollars, or imprisoned in the prison gaol not less than ten days nor more than six months, or both, at the discretion of the Court."

LEGISLATION IN TEXAS.—In the revised statutes of 1895 there is an important advance in the direction of establishing irrigation in Texas upon a firm footing. The following is an abstract of this law:—

Art. 3115.—All unappropriated waters of the State, ordinary flow, underflow, storm and rainfall, where the rainfall is

irregular or insufficient for agricultural purposes, are declared to be the property of the public, and may be acquired by appropriation for the purpose of irrigation.

Art. 3116.—The storm or rainwaters may be held or stored for beneficial purposes and diverted for irrigation, milling, waterworks and stock raising.

Art. 3117.—The ordinary flow or underflow of any streams may be diverted from its natural channel for irrigation, &c., provided that damage to a riparian owner may be determined by condemnation proceedings.

Art. 3118.—Appropriation of water is confined to objects enumerated in Art. 3116.

Art. 3119.—Priority of rights is determined by date of appropriation.

Art. 3120.—An appropriator, within 90 days after beginning construction of irrigation works, must file and record in the office of the county clerk a sworn statement of location of headgate, name of canal, size of canal in width and depth, carrying capacity in cubic feet per second, name of stream from which taken, time when work was commenced, name of owner and map showing route of canal. In case the water is taken from a reservoir, dam or lake the statement filed shall include the locality, name of survey upon which located, acreage covered, boundaries of reservoir or lake and area of watershed from which collected. With the filing of such statement, claimant's right relates back to time when construction began. Owners of works constructed prior to the passage of this Act shall file and record like statements within 90 days after the law goes into effect, but the failure to do so will not work a forfeiture of such rights nor prevent their establishment in the courts.

Art. 3122.—Rights to water for purposes stated in Art. 3116 may be acquired by filing and recording a sworn statement of declaration of intention with full description of proposed works; construction must begin within 90 days after filing said statement, and the work thereon must be prosecuted diligently and continuously to completion.

Art. 3123.—"Completion" is defined as carrying water in main canal to place of intended use.

Art. 3124.—Having acquired the right to divert water from a stream, no appropriator shall be deprived of the use of said water, or any part of it, except that riparian owners may use said water for domestic purposes; and any person whose land may be located within the watershed from which the storm waters are collected may construct dams upon his own land to store water for domestic purposes, but all excess of water above that lawfully appropriated may be appropriated by others.

Art. 3125.—Corporations may be formed and chartered for the purpose of constructing and operating works for the diversion of water, and shall have power to sell water rights secured by liens on land or otherwise, or otherwise dispose of the water under their control. All persons owning a possessory right to the use of water in a canal or other works shall be entitled to be supplied therefrom in accordance with contract terms; but if the price is not agreed upon, the owners of the water, having more than sufficient to meet existing contract requirements, must nevertheless deliver the water to such persons at such prices as may be reasonable and just; and in case of drought or accident, causing shortage in the supply, all consumers shall be provided *pro rata*, according to the amount to which each consumer is entitled. A permanent water right shall be an easement to the land and pass with the title thereof. Any instrument of writing providing a permanent water right may be recorded the same as land transfers.

Art. 3126.—Rights of way, 100 feet wide, over all public, free school, university and asylum lands, and the use of the material thereon for construction purposes, is granted to corporations and associations, and right of way over private lands and land for storage reservoirs may be obtained by contract or by condemnation proceedings. Water belonging into riparian owners may be obtained by condemnation and payment of damages to private property as provded in railroad cases, and the delay thus caused shall not work a prejudice to the person constructing the canal or other works.

Art. 3127.—Surplus water shall be returned to the stream from which taken.

Art. 3128.—Right of way along or across public highways is granted, but necessary bridges must be constructed and the usefulness of the highway in no way impaired. The route of a public highway over a dam site, reservoir or lake may be changed by the Commissioners' Court at the expense of the persons owning said site.

Art. 3129.—No cause of action for damages by live-stock shall accrue to owners of canals, &c., unless the same shall be kept securely fenced.

Art. 3130.—A superior preference lien upon all crops raised upon irrigated land is granted to persons owning the irrigation works which supply the water thereto under lease or contract.

Art. 3131.—Corporations organised under general laws are empowered to acquire lands for irrigation by donation or purchase or in payment of stock or water rights, to hold or transfer the same or borrow money thereon for construction, maintenance and operation of necessary irrigation works, and may issue bonds and mortgage its property to secure the payment of debts; but no stock or bonds shall be issued except for money paid, labour done or property actually received. All fictitious increase of stock or indebtedness shall be void. All lands acquired, except those used for the construction and maintenance of irrigation works, shall be alienated within 15 years from the date of their acquirement, or be subject to judicial forfeiture.

PENAL LAWS RELATING TO IRRIGATION.

Art. 482.—Any person who shall knowingly or wilfully destroy, injure or misplace any bridge, culvert, drain, sewer or ditch shall be guilty of a misdemeanour, and, upon conviction thereof, punished by a fine of not more than 500 dollars and shall be liable to the county and any person injured for all damages caused thereby.

Art. 495.—If any person amenable to the laws governing irrigation shall fail or refuse to work on any ditch or aqueduct when summoned so to do by the proper authority, he shall be fined not less than one dollar nor more than five dollars.

Art. 496.—Any person who shall wilfully or through gross negligence injure any irrigating canal or its appurtenances, wells or reservoirs, or shall waste the water thereof, or shall take the water therefrom without authority, shall be deemed guilty of a misdemeanour, and for each offence shall be liable to a fine not exceeding 500 dollars.

Many Japanese immigrants have settled in the rice belt and appear to find the industry profitable.

The capital invested in the rice industry of the Louisiana-Texas belt is estimated at 30,000,000 dollars, which includes lands, improvements, implements, pumping, plants, mills and canals.

There is every indication that rice growing will continue to increase, and that larger quantities will be exported in the future.—*Diplomatic and Consular Reports on the Rice Industry in the United States*, No. 625, pp. 1-26.

SUGAR PRODUCTION IN JAVA.

The production of sugar at 158 factories during 1907 was 18,088,369 pikuls. From this *De Indische Mercuur* calculates the entire production of the island at 19,444,238 pikuls or 1,200,854 tons.—ED

PLANT SANITATION.

A WHITE ANT EXTERMINATOR.

[The apparatus described in the following article has been fully tested by the Government Entomologist at the Royal Botanic Gardens. It has proved an unqualified success. Troublesome ant hills, of long standing, have been destroyed in a few minutes' time. A departmental circular, describing the apparatus and the manner of employment is in preparation.—E. E. G.]

In the "Natal Agricultural Journal" for July, 1906, Mr. Claude Fuller, Government Entomologist, illustrates and describes a machine for the destruction of white ants, placed on the market in South Africa by Messrs. P. Henwood, Soutter & Co., agents for the sale thereof.

This contrivance consists of an air-pump, connected by a short length of rubber hose to a furnace. By working the pump a continuous blast of air is driven into the furnace, entering beneath and escaping through a pipe near the top. A charcoal or cow-dung fire is first started in the furnace, and by pumping, got thoroughly alight. A powder is then sprinkled over the fire and the lid closed. By continuing the pumping a very hot cloud of poisonous smoke is driven out through a flexible hose. In use, the nose is inserted into a gallery of an ant's nest and the smoke pumped in.

Having had one of these machines in use for the past three or four months, I have no hesitation in saying that in the "Universal Ant Exterminator" we have the most efficient and effective apparatus for destroying white ants in their nests which has yet come under notice. Upon many occasions I have succeeded in killing out huge colonies—nests 15 and 20 feet across—where I have previously failed to destroy the lot. Treated nests which have been dug out reveal the death of every inhabitant, and show deposited upon the walls of every chamber and gallery a poisonous coating.

Two rather unique cases in the use of the pump are worth recording. In the first case a white-ants' nest was discovered beneath the flooring of a farm-house and dug out. Later, I loaned the machine to the owner in order that he might test its efficiency. White ants were noticed working at the mouth of a gallery 80 feet away from the house. Here the fumes were pumped in, and a few minutes later a cloud of smoke issued through the flooring of the room from beneath which the nest had previously been dug out. The gentleman to whom the machine was loaned has since purchased two, and is now working over the whole of an estate of 5,000 or 6,000 acres.

In the second instance honey bees had become a decided nuisance, making their nests between the lining and the roofing of a large verandah. Auger holes were bored through the ceiling boards, and the smoke pumped in through a length of iron piping. The immediate result was to drive out the bees through every exit hole they knew of. Many dropped dead, but the majority escaped alive. Afterwards, of course, the bees returned, and, naturally enough, started to work cleaning away the deposit; this poisoned them off.

Wherever a gallery, sufficiently large to admit the nose of the hose, can be obtained (about half an inch in diameter), the machine can be used with the most satisfactory results; not only are the insects killed, but the gallery is thoroughly poisoned for an indefinite period.

The powder spoken of is sold with the pumps. A cheaper and equally effective powder can be obtained by farmers at the Department of Agriculture, Maritzburg, at 8d. per lb.—*The Queensland Agricultural Journal*, Vol. XX., Part I., January, 1908.

THE MOSQUITO BLIGHT IN TEA.

DISCOVERY OF A NEW PREVENTIVE.

The Indian Tea Association are circulating for the information of tea planters a Note written by Mr. Hutchinson on preventive measures in connection with mosquito blight in tea.

Mr. Hutchinson in his Note deals with the discovery by Mr. Antram of a new soap solution cheaper and as deadly in its action as kerosine emulsion, which has hitherto been used for the purpose. He says:—

Owing to the unprecedented severity of this blight during the past season (1907) it has been considered advisable to devote special attention to methods of combating it. With this intention the Insectarium at Kanny Koory has been given up almost entirely during the past

three months to investigation of the life history of the insect, and more especially to the effect of various insecticides upon it at different stages of its growth.

The high cost of kerosine emulsion led to the conclusion that our first efforts should be directed towards the discovery of a cheaper and not less efficacious insecticide. After long and patient experiment, Mr. Antram has been successful in finding a solution which is equally as deadly in its action on the insect as kerosine emulsion, and at the same time can be applied at twice the rate per acre at one quarter the cost of the latter. The immediate object of this report is to make known the composition of this solution in time to allow of its use during the present cold weather after pruning.

The composition of the soap solution for mosquito blight is as follows:—"Primrose" soap 1 lb.; water 20 gallons. Primrose soap is an ordinary yellow bar soap, easily procurable in this country. It has been selected on account not only of its superior insecticidal effect, but for its property of forming a clean solution which will readily pass through the fine vermoral nozzle of the sprayer, other makes of soap having a tendency to form gritty deposits which choke the nozzle. The simplicity of the solution should make it easier to prepare and use than kerosine emulsion, nor has the soap solution any tendency to burn the bushes.

The solution should be applied at the rate of 300 gallons per acre for each round of spraying, the cost of which application will be about Rs. 2-8 per acre, as compared with Rs. 6 per acre required for applying 150 gallons of kerosine emulsion. —*Statesman*, 21st Feb., 1908.

[*Note by Mr. E. E. Green, Government Entomologist* :—

Spraying is only useful on completely isolated fields or where the whole area is pruned down at one time—as in India. In Ceylon, where the custom is to cut down one field at a time, any such remedial treatment is quickly negatived by invasion from surrounding fields. Recent experiments at Woburn have shewn that the best and most perfect emulsions are made without soap at all, but using a Bordeaux mixture made with clear lime water as the emulsifyer and a heavy oil (bulk oil) instead of kerosene.—See 8th Report, p. 24, *et seq.*]

LIVE STOCK.

VETERINARY NOTES.

RINDERPEST.

1. Next to the prevention of rinderpest, its treatment is one of the most important and interesting subjects in Veterinary Science. But a method which serves both as a preventive and curative of this fatal cattle disease is certainly of paramount importance in bovine therapeutics.

2. In India the inoculation of anti-rinderpest serum which is reputed to have this double effect, is coming into general use; and Major Rogers, the Indian Military Surgeon, in the course of his evidence before the Royal Commission on Vivisection, stated last year that he made arrangements for turning out 100,000 doses of this serum for use among Indian cattle.

3. The injection of glycerinated bile has also the two-fold benefit of being a prophlylactic and curative, but it is found that in India this method could not make any headway, owing to the deep-rooted prejudice of the native population against the destruction of cattle for the purpose of obtaining bile. Hence the advantage of the anti-rinderpest serum for general use in India. This fact applies with almost equal force to Ceylon too.

4. The last number of the Veterinary Journal to hand, viz., that of February, 1908, states that the annual out-put of this serum in India is 300,000 doses.

5. Of course, the preparation of this serum requires a properly equipped Laboratory and a special staff, and it may in the near future, form a subject for consideration whether advantage cannot be taken of the De Soysa Bacteriological Institute for this purpose.

6. With regard to the treatment of rinderpest, I have to note that quinine given in dram doses at the very outset will go a great way towards mitigating the disease. About eight ounces of Epsom salt should be combined with the first one or two doses of quinine administered during the stage of constipation.

FOOT-AND-MOUTH DISEASE.

7. With regard to foot-and-mouth disease, it is worthy of note that this disease assumes a mild form in India and Ceylon, whereas in Great Britain it is more virulent and fatal. But in and near a dairy, foot-and-mouth disease is a serious thing in Ceylon, too, and milk tainted with the virus of this disease is positively harmful, especially to children. It is, therefore, a wise precaution to scald milk before use when foot-and-mouth disease is reported in the vicinity.

8. The February number of the *British Medical Journal* speaks of a serious and somewhat alarming outbreak of foot-and-mouth disease among dairy cattle in Edinburgh. A herd of nearly 200 cows was destroyed as soon as 30 of them were found affected, and the owner of the infected herd will, it is said, have to be compensated to the extent of something like £4,000

E. T. HOOLE.

MISCELLANEOUS.

SCHOOL GARDEN WORK AND THE NORMAL SCHOOL.

By W. A. Baldwin,
Principal. State Normal School,
Hyannis, Mass.

In the brief time at my disposal I cannot do better than to analyze the forces which have driven the Hyannis Normal School to take up the school garden work. I venture to consider this account as worthy of presentation, because I believe that it is typical of what is happening or must soon happen to every progressive normal school. Modern pedagogy demands that there must be a basis in sense and perception along every line. We are, therefore, driven to one of two courses. First, let the child alone to get experiences as may come to him. Second, select or help him to select such typical experiences as would seem to furnish him with the needed basal experiences. We used to leave the matter to chance, and we inclined even to disregard the valuable experience gained by the child in his haphazard way. With the advance in science it has become impossible to leave the whole matter to Providence, and we have been inclined to go as far the other way, leaving nothing to individual initiative. The result has been such work as the regulation sloyd manual training. In slavish imitation of others we have put sloyd into our Training School. It was not producing the desired results, and we began to consider the matter. The problem as it presented itself to us was something like this. What form or forms of manual training are best adapted to produce the desired results? We were then driven to consider more carefully than ever before just what results we were aiming to secure. This has proved for us a fruitful question which is not yet fully answered. We soon became convinced, however, that such work should process the following characteristics:—

1. It should grow out of the environment of the child.
2. It should come as a response to something from within the normal child.
3. It should be typical of important world activities.
4. It should furnish ample opportunities for the child to act himself out in connection with typical activities and relations to things and to people. The first three are to such an audience as we have to-day obvious. The last is less obvious but vastly important. Let us consider it for a moment. Unless a child is allowed to act himself out there is no opportunity to discover his weakness, and to help him to grow strong. If he acts himself out with things which are not typical there is no especial gain. If the relations are artificial and unusual false associations are formed, false standards are established, wrong habits and wrong attitude toward life are fostered. These results have troubled the thoughtful observer in connection with regulation manual training in wood and iron, and even in regulation cooking courses, when not connected with home needs, and sewing, when based upon a system of models. Becoming dissatisfied with the regulation manual training we looked about for something better. We found several forms which pleased us and which we are using, but none which, on the whole, proved as satisfactory as has school gardening. It furnishes for us all of the requisites given above. It gives some organic untiy to our nature study. It furnishes one centre for correlation of our so-called regular school work. It helps on the physical side by getting the children and teachers out-of-doors a part of the day. It helps to establish proper relations between the school and the home and the world. It is true that some city normal schools are, by the artificial conditions with which they and their graduates have to contend, deprived of many of these privileges, but the majority of the graduates of our normal schools may and should use some form of school garden work, in connection with their school work. I have already said and written so much regarding the use of the school garden as a basis for other school work and social work that I will only say here that any one who is interested enough to write for a catalogue may receive some account of our work along that line. It seems wise to us to put this work in three times during our nine years of primary and grammar schools. The reasons I shall be glad to state if anyone is interested to have them. Until last year we had not given school garden work to our normal students. They had observed the work of the children, and, in some cases, had gained experience in teaching the subject during their practice term, but the majority went out without any adequate experience which would enable them to do the work in the schools where they were to teach. Gradually it dawned upon us that we were doing for our normal students just what we were criticising others for doing with the children,

viz., depending upon any chance experiences which they might have picked up and upon a little observation work, as a basis for understanding this very important branch of school work. We have now made the school garden an intrinsic part of our course in botany. Every student has his own garden. This experience is supplemented by observation and discussion of the work of the children of the Training School and by as much teaching as it is possible to allow. The present demand for teachers in this subject would not warrant every student in paying so much attention to this subject were there no other gain. We, however, believe that apart from such demand this kind of work furnishes a splendid opportunity to put into concrete form some of the most important principles of modern pedagogy, principles which ought to underlie all good teaching. I ought to say in closing that such preparation does not insure successful work in this subject on the part of every graduate. This is particularly true if the graduate is expected to inaugurate the school garden movement in a town or village. Such inauguration needs a person of strong personality, sanguine temperament, and much common sense. Given such a person with such training and I do not fear for the results.—*Transactions of the Massachusetts Horticultural Society for the year 1906, Part 11.*

THE EDUCATIONAL VALUE OF SCHOOL GARDENS.

By Hon. George H. Martin,
Secretary. State Board of Education, Boston, Mass.

It is hardly necessary, in view of the widespread and rapidly spreading interests in school garden work, that I should appear here this afternoon to speak of the educational advantages of them. They have been already discovered by the two organizations in the State which are devoted to the agricultural and horticultural interests. The State Board of Agriculture is fully alive to the importance of school gardening as preparatory in a way and supplementry in another way to the agricultural work of the State for which it is organized, and the Horticultural Society has already gone so far in its leadership in the movement that any discussion cannot be for the purpose of convincing them. The Superintendents of the State are rapidly becoming interested in the movement, and they have discovered educational advantages. The fact that last year there were some three hundred school gardens in the State is evidence of this. While it would seem from the report which Mr. Adams has read of the prizes that were given, that school gardening was comparatively limited in its scope, and but a small number of places are undertaking this work, there is not a county in the State in which there are not school gardens, and the towns and cities are already taking up the work with increased interest. They are going about it with increased intelligence; year by year it is better organized and better related to the other school work than at the start; and yet there is room for development. There seem to me to be three strong educational reasons why the school garden movement should spread until it becomes universal, for it is my own personal feeling that the time is coming when the school garden will be considered as important in the equipment of any public school as a library. The educational reason is that the garden appeals to the interest of the children in seeing something happen and in watching the development of the plant life in their gardens. In watching, too, the development of animal life, insect life, bird life in connection with their gardens. There is always something for the child to look forward to, always something to excite his curiosity and his wonder, and we know how profound those feelings are in interesting the child. He is expecting something to happen, and is inclined to be eager to see whether it does happen, and if so when and how, and by and by what it happens. This is the feature of it which gives the garden its chief educational value in that it appeals to the child more directly than any other form of school work. We have had nothing before which satisfied those feelings; all the school activities in the past connect themselves very slightly with life of any sort. Most of them have been in the air rather than on the ground, and the advantage is that this work is on the ground. It keeps the child where he is and is within his reach. That is the first educational advantage. The second is that it allies itself with the other school activities as perhaps no single school activity does. That is true of any form of manual school work, but this touches at more points than anything else we can think of, and it brings an air of reality and vitality to the other school exercises. It allies itself directly with what we call the language work, taking it out of the air into the ground, out of the theoretical into the real, out of the scholastic atmosphere into the atmosphere of real life. The opportunities for developing both the oral and written language of the child through the school garden seem to me almost endless. It allies itself not only with the literary

work but with the drawing. It brings that too into the realm of reality. It gives the child a reason for doing the work that is set for him to do, and it adds life and interest to every feature of the drawing work, every department of it. It connects itself and may connect itself much more than it has in the past, as Mr. Baldwin has shown in his Hyannis work, with the number work. He has shown what it does for the arithmetic work. Children find in connecting their arithmetic with their gardening work they are dealing with real things in a real way and for a purpose which is their own, for every problem has an end. They are doing these because there is something there that they want to find out. The children write in connection with it because there are things there that they cannot describe in words. It is because they want to use these things that makes the work so effective. It connects itself not only with the language, the number and drawing, but it connects itself and lays a foundation for a much more advanced work in the higher department of school, and I have felt very strongly that the school garden is an essential to the high school; it is the most effective laboratory a high school could use. The department of biology would be vitalized if it were connected with the school garden; familiarity with the features of school gardening would do as much for the study of literature, rendering plain the figures of rhetoric with which literature abounds. I believe it is idle for any teacher to try to teach literature by explaining in words what these figures mean. Both for the high and the elementary schools the school garden is to come in and will be found to be the most effective and useful laboratory that can be maintained to-day. A third reason is the social side of the garden. It connects itself so closely with the home life of the child. That is our one great need at present. It is to be the work of the immediate future to bring the school and home back into their old-time relations, and I think by means of this work it can be done. The children are applying at home what they have learned at the school garden, and this will be a means of binding the two together. Such work as Mr. Hastings has done in Fitchburg is useful, especially in a city where perhaps a school garden may not be practicable, but where in every home there are opportunities for giving the children the same sort of training. These seem to me, Mr. Chairman, the three most essential features; the fact that it appeals to the instinctive craving of the child for life process, the fact that it renders vital other school work, and that it tends to connect the school and home as nothing else does. I may seem extravagant in my claims, but I have learned to become interested in it, and every year as I have watched it, it has grown upon me as one of the valuable features possible in public school work.—*Transactions of the Massachusetts Horticultural Society for the year 1906, Part II.*

HORTICULTURAL EDUCATION FOR SCHOOL GARDEN TEACHERS.

By F. A. WAUGH,
Professor of Horticulture and Landscape Gardening, Mass., Agricultural College, Amherst, Mass.

In all the conferences on school gardens that we have held, and in all discussions on these topics the first practical question to come up has been that of knowing how to make the garden itself. In other words, the horticultural question seems to be fundamental. Over and over this point has been emphasized, that a school garden must be successful first as a garden before it can be a successful educational enterprise. This, of course, is requiring a good deal of the teacher, because horticulture is a long art; and if one must be an expert teacher, and before that an expert horticulturist, that is certainly asking a good deal for 45 dollars a month. It is hardly to be expected that every school teacher will become an expert horticulturist, and yet we cannot for a moment relax our emphasis on this point. Again and again it appears imperatively that we must know more horticulture. Having determined so much, the next question follows closely after. Where, how, and when are school garden teachers to get their knowledge of horticulture? Some one said a long time ago that to train a good woman you must begin with her grandmother, In a somewhat similar way, to make a good horticulturist you should begin with the grandmother. Horticultural education ought to begin early. It certainly is a great advantage to every teacher to be born on a farm. The early farm experience is invaluable. It is especially so to a young man, but even the girls get a good deal out of farm life. That experience of childhood, on the farm, is worth everything to the one who takes it rightly. I know there are some to whom this farm life has meant nothing, and my heart bleeds for those men and women who look back on such a childhood with bitterness. To me it seems the most delightful experience a

child can have. It seems to me the best possible foundation for all kinds of education. Out of this experience there should come a true love of rural life in all its large aspects—a love of growing plants, of animals and of the land. There should be a real love for the soil. There are times when I go into the field as the mellow furrows are being turned by the plow when the whole land looks good enough to eat. If one's experience of country life has given him or her this feeling with regard to the soil and to all those things connected with it, that is the best possible foundation for teaching school gardening. This sort of an experience and enthusiasm should create through the teacher a school garden atmosphere which is invaluable in this line of teaching. All of us know that each particular school has its special atmosphere. The high school has its bookish atmosphere. The technical school has its scientific atmosphere; and so the school garden should have a garden atmosphere. This fundamental condition for success should grow out of the natural love and enthusiasm of the soil which I have attempted to sketch. When teachers undertake to learn school gardening they should get their instruction in a garden. Now, there are all kinds of gardens, and all are good; but for this purpose I should say that a well-kept garden is essential. For the purpose of the present discussion it is convenient to divide all gardens into two classes, the amateur gardens and the professional gardens. The point of view in these two different schemes is radically diverse. The amateur garden is conducted for the fun of it, while the professional gardener grows plants for profit only. I should say that a better atmosphere for the school garden teacher is to be secured in the professionally conducted garden. I would recommend that the school garden teacher get his or her knowledge of gardening from the professional gardener. There are special garden courses, or courses in general horticulture now being established in various schools; and we may expect that in the future these will give some opportunity for the training of school garden teachers. Various academies are now enlarging their work so as to include agricultural and horticultural courses. Yet for thorough work in school gardening these secondary schools can hardly furnish the proper grade of teachers. In looking for such teachers it is somewhat natural to turn toward the larger institutions which are better equipped for this sort of work. Of course, I am prejudiced in this matter—a prejudice which I freely admit—but there seems to me to be no fair question but that the best opportunity for teaching horticulture in this neighbourhood is to be found at the Massachusetts Agricultural College. We have at college many acres of orchard, garden, and woodland, as well as fields devoted to general farm crop, and fields devoted to special experiments, all managed as well as circumstances allow. All the various agricultural activities of this country and climate are rather fully exemplified. And while that material up to the present time has not been used for the education of school garden teachers, it is easily capable of being turned to such account. There are some of our graduates who now leave college to teach. They must be to some extent prepared for school garden work; but teachers who look forward to real teaching and real school garden work need both normal school training and agricultural college training. It would seem therefore the natural and the best way to arrange this matter through some form of co-operation between the normal schools and the State Agricultural College. It seems both wise and convenient that normal school graduates who wish to take up school gardening should go to the agricultural college for their instruction in horticulture; and it seems equally proper that students of the agricultural college who intend to take up teaching should go to the normal school to secure their teaching methods. I see no difficulty in arranging some plan of co-operation between these institutions. Already steps are being taken at the agricultural college with the help of funds to be provided by the State for beginning some work of this kind. I understand that some negotiations are already underway looking toward such forms of co-operation as I have suggested. We may fairly expect therefore that in the near future we shall have opportunities of a large sort here in Massachusetts for those teachers who wish to prepare themselves well for school gardening. This may look like a large contract; for the present we know that not all teachers attend the normal schools even, and it may be expecting too much to ask them to attend the two colleges. Nevertheless, if the present plans are carried out, I am sure it will not be hard for more ambitious ones at least to get a great deal more training in the future than has been available in the past. The great problem in school gardening is to get the teachers, and the teacher's great problem is to get her knowledge of horticulture. We hope to do our share in providing her with reasonable opportunities.—*Transactions of the Massachusetts Horticultural Society for the year 1906. Part 11.*

[While we do not agree that an extensive training in gardening is necessary, for both master and scholars learn from mistakes, there is no doubt that an absolutely inexperienced teacher is in general useless for a school garden. In general, in Ceylon, we have gone upon the principle of establishing such gardens only where the master was keen about such work. The scheme is now growing to a size when proper training for the masters is worth consideration.—Ed.]

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TRANSPIRATION AND ANATOMICAL STRUCTURE IN TROPICAL PLANTS.

Der Einfluss des Klimas auf den Bau der Pflanzeng webe. Anatomisch-physiologische Untersuchungen in den Tropen. By Dr. Carl Holtermann. Pp. viii+249; plates. (Leipzig: W. Engelmann, 1907.) Price 12 marks.

Dr. Holtermann's investigations, mainly carried out in Ceylon, include a long series of experiments on the transpiration of different tropical plants. His tables show great variations in the amount of transpiration for the same plant during the same hours of different days, and these are in many cases not explained by the differing temperature and relative humidity, which are the only other data given. Thus, for instance, in the case of *Canna indica*, between 9-40 a.m. and

5-40 p.m. on January 11 (with a relative humidity of 61 and a temperature of 25°·4 at 10 a.m.), the transpiration was 0·37 gr. per hour per sq. dm. of leaf surface, while on January 17, between 9-45 a.m. and 5-30 p.m. (R.H. 63, temp. 26°·2. at 11-15 a.m.), the transpiration was 0·92 gr. per hour per sq. dm., and on January 18 between 9-15 a.m. and 3-30 p.m. the transpiration was 2·60 gr. per hour per sq. dm. (no humidity or temperature data are given within the period of the experiment, but judging from the late afternoon figures the day did not differ much from the others). This, though an extreme case, is only one out of several similar ones, and the effect of such figures on the reader is decidedly bewildering, though the striking variations may be explicable by changes of insolation, or the irregular occurrence or drying winds. As they stand, the author's figures only demonstrate that the transpiration of the plants studied exhibited startlingly wide fluctuations which remian quite unexplained.

The author's general conclusion from his experiments is that while the highest transpiration figures per hour in the tropics are considerably higher than any north European ones, yet active transpiration begins later and stops earlier in the day in the case of a damp tropical climate, so that the daily average is no higher than in Europe, while in the wet season transpiration may cease for weeks at a time. He thus does not disagree with the conclusions either of Haberlandt or of Giltay on this question. Dr. Holtermann holds that water-tissue is essentially an arrangement to supply water to the transpiring tissues during these short periods of excessive evaporation, not a means of lessening transpiration, and this view he supports by showing that it is especially developed in actively transpiring plants liable to be subjected to these sudden demands. It is characteristic of the leaves of tropical plants growing in a climate which is neither quite xerophytic nor constantly moist, and this harmonises with the short daily period of very active transpiration already mentioned. The mangroves, which ordinarily possess characteristic water-tissue, well developed, from much less or none at all in the leaves of examples cultivated in garden soil, which transpire very much more freely than plants growing in the natural salty soil. If these plants cultivated without salt are now watered with 3 per cent. salt solution and placed in the sun, they show a wilting of the leaves, and the mesophyll becomes shrivelled. Mangroves growing in their natural habitat also show wilting on hot afternoons, but only

the water-tissue is partially emptied and the leaves recover during the night. For the rest the author holds that the xerophily of mangroves and of other halophytes has been much overrated by Schimper and others. They are scarcely, if at all, more protected in this respect than many trees growing in similar situations but not in a salty soil.

Dr. Holtermann describes three other formations of stand-plants besides the mangroves, viz., first the plants of moist sand, which fall into two categories: (1) those growing on the edge of the sea, absorbing salt water, and possessing water-tissue; (2) those growing further from the sea, with fresh bottom-water, which have no special xerophilous adaptations. Secondly, the dune plants, a highly xerophilous type; and, thirdly the plants growing on salty mud, which have internal water-tissue, and resemble succulent desert-plants in many anatomical features. These three formations have close parallels among the strand formations of temperate regions. This classification is good so far as it goes, but it ignores the beach-jungle (Barringtonia-formation of Schimper), which the author apparently includes with the damp lowland forest type. Yet this formation, though not well developed in Ceylon, certainly has an independent existence; it is much in need of exact study and delimitation.

The author goes on to describe the damp lowland woods, the dry plains of the north and east, and the upland vegetation, as also the epiphytes and parasites of Ceylon. Many interesting observations are contained in this part of the work. Dr. Holtermann also discusses at some length the question of leaf-fall in the tropics, and concludes that though it is a hereditary character, it is, in the endemic species, determined by the dry season, and, in general, leaves fall when their structure does not fit them to withstand the conditions prevailing during the time the trees are bare. A similar explanation is given of the occurrence of annual rings of growth in the wood, the author relating the renewed formation of wide xylem elements to the increased transpiration taking place when a crop of young leaves is produced.

The final section of the work is devoted to a discussion of "Direct Adaptation," in the course of which an account is given of many interesting experiments which add considerably to our knowledge of adaptive reactions under new conditions. The author rightly classes all these as phenomena of irritability, but draws the conclusion that such characters, acquired during the lifetime of the individual, can in process of time be fixed and inherited. This conclusion is, of course, wholly unwarranted; in fact, it is totally irrelevant. And meanwhile the mystery of adaptive reaction, so widespread a phenomenon in the biological world, remains unsolved. Until we know a great deal more than we do at present about the physico-chemical connection of stimulus and response, it is likely to remain so.
—*Nature*, Feb, 6. A. G. T.

INDIAN AGRICULTURE.

BY HENRY STAVELEY LAWRENCE, I.C.S.,
Director of Agriculture, Bombay.
(*Continued from p.* 143.)

ESTABLISHMENT OF DEPARTMENT OF AGRICULTURE.

If this retrospect proves the fallacy of the view that Indian agriculture is, or has ever been, in a condition of unprogressive immutability, it remains to consider the responsibility of the State in regard to the guidance and encouragement of its progress, the machinery of the new Departmant of Agriculture, the programme of its work, and its prospect of success.

The arguments which are used in this country against State action, and which appears even here to be losing their influence on public opinion, are not equally applicable to India. The classes which possess wealth or landed estates are divorced by sentiment and tradition from the pursuit of agriculture, and the State is face to face with a vast peasant tenantry who are debarred by their ignorance from any knowledge of agricultural developments outside their village, and by their poverty from risking the smallest loss in new experiments.

Further, in a country where the land is nationalised, and the State draws one-third of its revenues from the national rental, it is peculiarly incumbent on the State to discharge functions which in a different economy may be regarded as the sphere of the private landowner.

This is, indeed, no new doctrine, though circumstances have conspired to postpone to the present time effective measures towards its realisation.

In 1854 the Court of Directors in the famous despatch which established higher education in India stated their opinion that "there was no single advantage that could be afforded to the vast rural population of India that would equal the introduction of an improved system of agriculture."

In 1870 the Government of Lord Mayo established a Department of Revenue and Agriculture in the belief that Indian agriculture was "susceptible of almost indefinite improvement.

The Department was abolished nine years later owing to financial pressure, but was re-established by Lord Ripon, in 1866, with the object of "maintaining agricultural operations at the highest attainable standard of efficiency." In pursuance of the instructions then laid down, valuable work was done in the preliminary study of agricultural conditions, the collection of statistics, the organisation of a system of agricultural credit, and in several provinces the investigation of the relations of landlord and tenant, with a view to the protection of tenants against rack-renting; but it was not until 1902, when Lord Curzon applied himself to the problem, that a body of scientific workers was appointed to the Department.

This staff has necessarily been recruited from European scientists, for education in India has not hitherto included a knowledge of the sciences subsidiary to agriculture, such as agricultural chemistry and botany, mycology and entomology; but though the direction must remain for a considerable period of time in European hands, the discovery and application of improvements must depend on the co-operation of the natives of the soil, and the first step to progress is recognised to be the establishment of Colleges of Agriculture in all the chief provinces.

Agricultural Education.

It is true that four agricultural institutions were in existence at the time, but all were, broadly speaking, inefficient. At Poona, five students picked up such fragments of information as a single officer, whose work extended over the Presidency of Bombay, could find time to give them. At Saidapet, in Madras, there was a similar course of instruction, conducted as at Poona, in English. At Cawnpore and Nagpur, courses were held in the vernacular languages, and teachers were recruited from the Poona and Saidapet institutions. Now new colleges have been established at Lyallpur in the Punjab, Bhagalpur in Bengal, and Coimbatore in Madras; Saidapet has been abolished; Cawnpore and Nagpur have converted their curriculum into English; and Poona has been expanded and improved. I am not acquainted with the details of the changes elsewhere than at Poona; but all the institutions follow the same model, and at Poona there are now three full-time European professors of agriculture, chemistry, and botany, with Indian assistants in these branches and in entomology and veterinary science. For the present, work is being conducted on temporary premises, but an estate of 160 acres has been purchased on which the college is in course of construction with a full equipment of laboratories and lecture-rooms, to be followed shortly by residential quarters for the professors and 200 students. Great stress is laid on practical work in the field, and Poona is well furnished with opportunities. A home farm of fifty acres is attached to the college; a dairy farm of similar size is adjacent; within three miles there are 100 acres of botanical gardens, and eight miles distant the sugar-cane experimental farm at Manjhri. Students join about the age of seventeen, when they have passed the previous examination; that is, when they have taken the first year's course leading to the arts degree at the University, and have thus received a fair general education and acquired a good working knowledge of English. The college course extends over three years, after which the candidates selected for the Department of Agriculture spend a further period of probation in practical duties on the experimental farms. In a few exceptional cases men have been sent on to Cambridge to fit themselves for appointment to the higher posts in the new provincial service.

Fears were expressed that an agricultural training would have no attraction for the educated youth of Bombay, and that the College would stand empty. So far these fears have been falsified. Where some years ago there were five students, there are now 95. The popularity of the new college is not solely due to the awakening of an interest in agriculture throughout the country; although indications of such a movement are not wanting, the field of private employment is as yet restricted. For the most part the students desire Government service either in the agricultural or revenue departments; and the latter has recently been thrown open to them by the Government of Bombay in the belief that an agricultural training can be as truly educative as a literary training, and that habits of scientific observation cannot fail to be beneficial to officers whose duties bring them at every turn into contact with village life.

The view was also put forward that in order to bring the college within the reach of the agricultural classes, instruction should be imparted in a vernacular language and not in English. The old controversies die hard; the arguments with which Lord Macaulay demolished his adversaries in 1835 are equally valid

to-day; while in the Bombay Presidency where five distinct vernacular languages are spoken, English is the only possible *lingua franca*. Moreover, English education has so pervaded this Presidency that it is no longer the monopoly of the professional classes; and, as a matter of fact, of the Poona students, the majority had hereditary associations with the possession of land.

ORGANISATION.

The new policy demands a considerable increase of expenditure. In the Bombay Presidency, in place of an annual Budget of £3,000 which was chiefly devoted to the tabulation of agricultural statistics, there is now a Budget of £35,000. I have not access to the figures in other provinces, but an estimate of an increase for all India from £10,000 to £200,000 would not be far from the mark. When the schemes for the creation of the Department were laid before the Legislative Councils of the Government of India and of all the provinces, no adverse criticism was heard from any quarter. No projects, not even proposals for the remission of taxation, have ever been greeted with greater unanimity of approval from the representatives of Indian public opinion; and, indeed, if we compare the allotment with the size of the country, or the scope of the operations of the Department, it ceases to appear extravagantly liberal. Our American friends, who spend £2,300,000 a year on their department, and are satisfied that they get their full value for their money, would regard it as a very humble beginning.

The organisation of the department is as follows:—At the head stands the Inspector-General of Agriculture to the Government of India; whose functions are to advise the Government on all agricultural questions, to superintend the work of the Research Institute, established at Pusa, in Bengal, and to observe the operations of the several provincial departments, with a view to their co-ordination.

The Research Institute, at Pusa, is announced to be primarily concerned with "the solution of the fundamental problems of tropical agriculture." The staff comprises European scientists in agricultural chemistry and botany, entomology, horticulture, mycology, and plant physiology; and a number of native assistants in these sciences.

Each local Government has a separate provincial department in the charge of a Director appointed from the Indian Civil Service, who advises his Government, adminsters the department, and keeps it in touch with the officers of the revenue, forest, irrigation, and other cognate departments and most important of all—interprets its work to the landowner and the cultivator.

Under the Director there is the educational work of the College of Agriculture and the executive work of the experimental stations. For the latter purpose the province is divided into two or more circles, each under the supervision of an European agricultural expert, styled the Deputy-Director. This officer studies the crops of chief importance in his circle, and the local conditions and methods. In the botanical and chemical problems involved he has the assistance of the professors of the college. His programme of experiments is drawn up in consultation with them and is annually subjected to criticism by the Board of Agriculture. This Board includes the whole agricultural staff of India, and meets in conference once a year; by the interchange of information and criticism it is hoped to secure continuity in the experiments and to avoid unnecessary duplication and repetition of enquiries.

In the Bombay Presidency, where five years ago there were three experimental stations, there are now thirteen. Each is in charge of a native officer of good education who has been specially trained in the department. Two of the farms, which are intended to serve as seed farms for the distribution of selected seed of cotton and millet, have areas of over 200 acres; the rest vary in size from 20 to 75 acres.

ADMINISTRATION.

Up to date the work of the department has been chiefly, in the most literal sense, preliminary spade work; the preparation of the farms for experiments. The impatient reformer who seeks for revolutions in India will meet with disappointment in Indian agriculture as in other fields of activity. Some advocate the establishment of agricultural associations in every district, and demand, as is the way of the East, that Government should finance their operations; others suggest that to every school there should be attached a farm or garden, not merely as a useful guide to Nature-study, but for the demonstration of new crops and methods. Such measures would throw open the door to lavish waste of money, and in many cases prove wholly mischievous.

The difficulty of securing the judicious treatment of a new plant or method can be appreciated by all who have tried to introduce an exotic into their gardens under the care of an old-fashioned gardener, but where the problem comprehends also the application of an un-

tried fertiliser, and the minute comparison of the cost of each operation, from the preparation of the soil to the marketing of the produce, the disasters which attend on the ignorance or carelessness of an untrained staff are many times multiplied. An error in the management may destroy the result of the experiment, and an error in elaborate calculation of the costs may place an improvement beyond the reach of the small cultivator. And the capacity of the small cultivator is the standard by which almost all improvements in India must be regulated. It is futile, for instance, to preach to him the advantages of deep ploughing in tracts where his cattle are too small and weak to draw a heavy plough, or where he cannot afford to buy an iron plough or keep it in repair.

It is of the first importance, then, that the experimental stations should be equipped with an efficient staff, and that the results of their experiments should command absolute confidence. When improvements have been discovered the next question is how to procure their adoption by the cultivator. Various methods are favoured in the several provinces. Some issue agricultural journals; others supply matter to the native press; in some provinces agricultural associations have been established in large numbers, under official inspiration; in others a more cautious procedure is adopted, and it is proposed to postpone the development of associations, until the department is in a position to afford them the assistance of trained officers. Other measures taken are: the encouragement of agricultural shows; the cultivation of demonstration plots in selected villages; the conduct of excursions of villagers from outlying tracts of similar character to the experimental farm; and the despatch of itinerant inspectors to lecture and to demonstrate in distant villages. The last two measures have been found especially useful in the Bombay Presidency.

Illustrations of the various methods adopted could be given from the valuable work done in Madras on sugar-cane and groundnut; in the United Provinces on wheat; in the Central Provinces on cotton; but I will confine myself to a few instances which came under my personal notice in Bombay.

The sugar-cane cultivation at Poona is of the highest character in India, and will bear comparison even with the cultivation of Mauritius. While in Upper India the average out-turn of raw sugar is about 1¼ tons per acre; in Poona, with the aid of ample irrigation and supplies of manure, as much as six tons have been obtained, and an outlay of £20 per acre on fertilisers has brought in an equal sum of net profit. A discovery of far-reaching importance has here been made that oil-cakes will supply the nitrogen required for this crop at the cheapest possible rate.

Parties of cultivators from the canal districts of the Deccan have been taken to see these results, and the keenness of their interest was evinced by the severe cross-examination to which they subjected the farm staff in regard to all the methods and manures employed.

Again, at Dharwar, though the farm has only been started three years, a useful local improvement has been shown to the people. The tract is infested with a deep-rooted grass weed which could only be kept in check by the expensive process of hand-digging. It was demonstrated that an iron plough could clean the fields at a fraction of the expense, and could be drawn by the local oxen. Large landholders came from all parts of the district to see the tests, and, being satisfied of the economy, purchased a number of the ploughs.

On the Deccan canals, where the experience of the Poona Farm enables definite recommendation to be made with confidence, itinerant inspectors have been sent out to tour, with instructions to warn the villagers of the dangers of over-irrigation and water-logging; to advise them as to the manuring of sugar-cane, and to assist them in the cultivation of long-stapled cotton. These tours proved a great success in attracting the interest of the best classes of cultivators, but so far only two men could be spared for the work. It is essential that such men, if they are to overcome the distrust and scepticism of the villager, should be tactful and experienced, and have a thorough working knowledge of their business. The premature despatch of inefficient youths on this duty would only bring the department and all its work into derision, such as was excited some time ago by a circular issued by an amateur agricultural association, in which farmers were recommended to fertilise their fields by killing mad dogs and burying their carcases.

Past experience has proved the danger of the recommendation of untested improvements. During one famine large quantities of carrot seed were imported, as a sure and rapid source of food; the precious remnant of moisture in the river beds was exhausted in a vain attempt to grow carrots, where the indigenous millet would have given invaluable relief. Drought-resisting tapioca cuttings have been imported from

the West Indies, where no drought is known comparable to an Indian drought, in ignorance of the fact that tapioca abounded in India; drought-resisting grasses from Australia have been widely distributed and have been found to grow with success only on the margin of running streams; windmills have been imported in numbers in tracts where the wind was either excessive or too capricious for utilisation; and the failures of foreign machinery have been innumerable.

These cases exemplify the negative benefits that may be expected from the new department. It is something gained to have a safeguard against the commission of such errors in future. From the same point of view the Bombay Government require every officer of the Indian Civil Service in their employ to study the elementary problems of Indian agriculture during a short course at Poona. The knowledge thus acquired will not create an agricultural expert, but will enable the officer to avoid egregious mistakes, to win the confidence of the people by an intelligent sympathy with their difficulties, and to act as a link between them and the department.

From these dry administrative details let us turn to the chief products of India and take a brief survey of some of the questions under investigation. The department are somewhat bewildered with the multitude of problems pressed upon their attention, and are fortunate that, in seeking to concentrate their efforts on definite points of the greatest urgency, they have the support of the Royal Society here in London, who have most generously placed their advice and assistance at the service of the Government of India. Cloves and nutmegs have their own allurement for the specialist, but sugar and wheat are of greater importance to the country. If we are to view these conflicting interests in their proper perspective, a few statistics are indispensable, but as some apology for their introduction let me assure you that they are mere approximations and have no claim to precise accuracy.

SUGAR.

We will take sugar first, for not only is it the typical product of India from the dawn of history, but it presents today every variety of unsolved problem for scientific enquiry.

India is the undisputed parent of the sugar-cane cultivation of the world. The Greeks mention with astonishment how they saw honey made by the hands of men; the Arabs carried it to the Mediterranean and Spain, and at the famous College of Natural Sciences, at Jundisapur, invented the art of sugar refining. Until the fourteenth century, in this country, we knew no source of sweetness other than honey, and the first recorded imports of sugar took place in 1319, when fifty tons were received from Venice, and were sold at the price of 1s. 9d. per lb., or the equivalent of 21 shillings of our present currency.

In former days, India exported sugar; now she imports, roughly, a quarter million tons of refined sugar, valued at about £4 million sterling. The demand which has arisen for refined, in place of unrefined sugar, cannot as yet be supplied by sugar factories in India. Sugar and sweetmeats are the Indian equivalent for the English glass of beer, and consumption increases with prosperity. It is satisfactory to note that the output of raw sugar is still twenty times as great as these imports, that the price has not been reduced by foreign competition, and that in those British provinces where alone comparison is possible, the statistics show no decrease in the yield.

There is no crop regarding the cultivation, harvesting, and manufacture of which agriculturists, European and native alike, have so little certain knowledge. The number of varieties with distinct characteristics is very great; some require ample irrigation and contain a high percentage of sugar; others will grow with a minimum of moisture, but give a reduced out-turn; others, again, are preferred for the hard fibre which resists the attacks of jackals and wild boar. The entomologist studies devices for circumventing the white ant and the sugar-borer pest; the mycologist investigates the red-rot fungus (*Colletrochicum falcatum*); while the chemist is required not only to advise on the comparative value of fertilisers, but also to determine the period of ripening, and the sugar content of different varieties. If sugar is to be refined, the aid of the chemist is also required in the further processes.

In all these matters much work has already been done, but much more remains. Though canes have been imported from all sugar-producing countries, the distribution to each tract of the variety best suited to its conditions is far from settled. A great impediment to the industry is the inefficiency of the mill for expressing the juice; in the United Provinces, where thorough experiments have been made to reduce the cost of the native methods of treatment, the conclusion is that the establishment by private enterprise of agencies for the sale, hire, and maintenance in good

repair of cane-mills, boiling-pans, and centrifugals is the greatest need of the industry.

WHEAT.

Wheat covers an area in British India of some 25 million acres, and has an outturn of some 7 million tons, and a value of £42 million sterling.

The varieties cultivated are exceedingly numerous and differ greatly in quality. Many spasmodic attempts have been made to extend the cultivation of the superior soft varieties but with little success, for they either refuse to grow or deteriorate rapidly. The yield is estimated to average 5 cwt. or 9 bushels per acre—an outturn similar to that recorded in England 500 years ago—but with irrigation and manure it rises to 15 cwt.

In certain tracts where cloudy weather is apt to induce rust, only the inferior varieties which are resistant to this disease can be grown. Hopes are entertained that by hybridisation varieties may be obtained which will combine this resistant power with a superior quality of grain; and systematic investigation is being conducted to ascertain by selection the most profitable variety adapted to each soil and climate.

JUTE.

Jute has recently come into the front rank of Indian industries. The great increase in the demand for fibres has doubled its price in the last five years, with the result that the area cultivated has risen in that period from two to three million acres, and the crop in 1906 was estimated to be worth £35 million, sterling.

A hundred years ago it was an unknown commodity to the markets of the world, and was only used as the material for the coarse sackcloth worn by the peasants of Bengal.

The cultivation is still restricted to the provinces of Bengal and Assam, but efforts are being made to introduce it to other provinces. A survey has just been made of all tracts in India which appear to be suitable to the crop, and skilled cultivators from Bengal were despatched to conduct experiments on the agricultural stations. In its original home jute ripens in three to four months with a rainfall of thirty to forty inches and a soil of sandy loam. It may be sown in March, April, or May, and harvested in July and August. Some sixty varieties are known to Bengal, and several alternative roads to success offer themselves for investigation. Areas may be found with climatic conditions similar to those prevailing in Bengal; irrigation from canals may prove an efficient substitute for rainfall; or varieties may be discovered which will adapt themselves to different soil and scantier moisture. The large out-turn and high value of the crop is an incentive to perseverance in these researches, for while cotton on an average will yield less than a cwt. of lint to the acre, worth, say a couple of pounds, jute will produce 10 cwt. of fibre worth about 12 pounds.

(To be continued.)

OUR PLANT IMMIGRANTS:*

AN ACCOUNT OF SOME OF THE RESULTS OF TEH WORK OF THE OFFICE OF SEED AND PLANT INTRODUCTION OF THE DEPARTMENT OF AGRICULTURE AND OF SOME OF THE PROBLEMS IN PROCESS OF SOLUTION.

BY DAVID FAIRCHILD,
Agricultural Explorer, in Charge of Foreign Explorations.

The era of pork and hominy has passed for ever in this country, but so short a time ago that our fathers refer to it as the time of plain living. What has wrought this change throughout the table menus of the country since the days of the California gold fever? It is not the gold fields of the Pacific slope, nor the industrial development of the country that has caused it, so much as the introduction of new food plants. The changes that have been going on since those waggon caravans followed each other across the great plains have been gigantic, but in no respect have they been more remarkable than in those which Plant Introduction has brought about.

Slowly at first, with the establishment of those plants that the immigrants brought over with them, this work has gone on, unchronicled by historians, until to-day the very things that we look upon as characteristic of great regions of the country are vast fields and enormous orchards of introduced plants.

SOME NOTED IMPORTATIONS.

The discovery of gold at Stutter's mill was the beginning of the great industrial development of the Pacific Coast, but the introduction by the Catholic Fathers of a single forage plant—alfalfa—has turned two million acres of land into the most generally profitable farm area of this country.

The same Fathers brought with them to their missions olive cuttings, whose descendants to-day cover thousands of

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* The substance of an address to the National Geographic Society, February 9, 1906, and published by permission of the Secretary of Agriculture.

acres of the best tilled olive orchards in the world. A few orange cuttings from the east coast of Brazil, called to the attention of the world by an American woman, have grown until they number their descendants by millions and form what is one of the characteristic features of California—its orange groves.

The tomato, which before the war was a curiosity from Peru and was used to frighten slaves into obedience, because they thought it poisonous, was grown last year on over half a million acres of garden land.

The lima bean, whose arrival in this country no historian has considered worthy of chronicling, has so grown in importance since its introduction, some time about 1820, that to-day special freight rates are granted it between Southern California and the Atlantic coast, and thousands of acres of land are devoted almost exclusively to the cultivatian of this Peruvian bean.

The potato, from the highlands of Colombia and Peru; the rhubarb, from Central Asia; the asparagus, from England; and even the celery of Southern Europe, have all been, one after the other, introduced into our fields and gardens.

Though these great changes in the farm and garden areas of the country have been wrought in less than a lifetime, they have still been too slow, and to-day changes as far-reaching and important as the introduction of the olive or the orange are being brought about by Government aid in a surprisingly short time.

The Department of Agriculture is growing in this country some of the things that we now import and for which we pay annually many millions of dollars; it is forcing into public notice and encouraging the trial of foods that the people of other countries find excellent, and of which we are ignorant; and it is bringing in from all parts of the world plants that are now wild, but that can be tamed by breeding with others now in cultivation, thus contributing to the creation of fruits and vegetables that the world has never seen before.

This is the Government enterprise of Plant Introduction—to introduce and establish in America as many of the valuable crops of the world as can be grown here; to educate the farmer in their culture and the public in their use; to increase by this, one of the most powerful means, the agricultural wealth of the country.

OUR FARMS AND FARMERS THE BEST IN THE WORLD.

No nation in the world has an agricultural territory with a greater range of climatic conditions than the United States and its possessions. Great Britain, "on whose flag the sun never sets," has her Colonies scattered through all the possible ranges of climate, but America has in one great connected area a territory that is exposed in its north to a temperature of fifty degrees below zero in winter and whose southern tip juts out into the zone of perpetual warmth.

This great farm land is peopled from one end to the other with pioneers; not with peasants whose fathers and grandfathers were peasants and who follow blindly in the footsteps of their forefathers, but with men who have the spirit of change in them and who are looking for anything that will pay better than what they already have. These pioneers, through the daily press and by means of the rural free delivery, are keeping in touch with the plant industries all over the world. They know what the wheat crop of the Argentine is likely to be, and whether Russia's output of this grain will affect the price of the wheat in their stacks. They see accounts of plant cultures in other lands that they would like to try in their own fields or gardens, and they have the time and the money and the land necessary; but they cannot get the seeds or plants to experiment with, nor dc the papers tell enough to enable them to judge whether there is any chance of successfully growing these strange crops on their land.

"NEW THINGS TO GROW."

Millions of dollars are waiting to be invested in these new crops, and hundreds of thousands of private experimenters are ready to try new things. A flood of emigration has set in from our great cities to the country, and the emigrants are not poor people, nor ignorant, but are in large part the wealthy and intelligent, few of whom are willing to follow in the old ways of farming and gardening. They want something new to grow, not always because they think it will be more profitable, but because they will get more amusement out of it. To manage a farm and make it pay along the old lines is indeed a great accomplishment, but to take up something entirely new and prove that it will grow and be profitable gives the same kind of pleasure that always comes to one who makes two blades of grass grow where one grew before. It is the keen pleasure of discovery, the old pioneer spirit, that is

turning from the creating of new business projects into new fields of agriculture. These are the new conditions in American agriculture that must be met by new means, and the Department of Agriculture, through the Office of Seed and Plant Introduction, is striving to meet these demands. This office, with its small appropriation of $40,000 a year for the introduction of foreign plants, is getting seeds and plants from the most remote corners of the world for thousands of private experimenters and for the State Experiment Stations of the country. Over a dozen new things a day are entered on the list of new arrivals, and these new seeds or plants arrive by mail, express, and freight, in quantities varying from a single cutting in a tin tube to a ton of seed of some African or Arabian grain.

These things are not sent broadcast over the country; they cannot be had merely for the asking. Each new shipment represents a well-thought-out problem, for which some preparation has been made, and the seed is too valuable to be wasted by putting it in the hands of those who want it merely because it costs nothing, or who live in a region which the meteorological data in the office excludes from consideration as a place where the new plant is likely to find a congenial home. The new arrival goes out to some experiment station or to some one who has satisfied the office that he has the necessary means to take care of it and the soil and climate in which it will be likely to grow—to experimenters, in other words, who have demonstrated their ability to try new plants. These are chosen from the organized institutes of research in each State and by correspondence with private individuals.

AGRICULTURAL EXPLORERS.

The securing of these things from the ends of the earth is a work that has required the employment of exceptional men, whose enthusiasm for discovery would take them into dangerous places and whose training had fitted them to tell at a glance whether there was in a new plant the possibility of its utilization in this country. These men have been botanists in the main, but not collectors of dried plants. They have been investigators of new crop possibilities, and have kept always in view the fact that what the country wants is something that will grow and be profitable. The finding of a new species did not distract them from the object of their search, which was to find the plant, whether new to science or not, that was wanted for the improvement of an existing industry or the establishment of a new one.

The ground covered by these agricultural explorers has been great, and in this work of exploration the office has been most fortunate in enlisting the personal support of America's greatest traveller, Mr. Barbour Lathrop, of Chicago. Mr. Lathrop, at his own expense, conducted his explorations for nearly six years into most of the promising plant-growing regions of the world, taking the writer with him in all his travels as his expert. With the host of correspondents established during these long voyages, and those made by the various agricultural explorers that the office itself has kept in the field, the machinery of getting new plants is better organised in this office than anywhere else in the world. We have traversed the Russian steppes and entered Turkestan; we have scoured the coast of North Africa from the Suez Canal to Morocco, visiting oases in which no white man has been for twenty-five years; we have investigated the industries of Italy, Greece, and Austro-Hungary; the Valley of the Nile, with its host of irrigated crops, has been given a thorough study; Japan, with its peculiar and suggestive agriculture, has been drawn upon by our explorers; India and the Dutch East Indies, with their wealth of material of value for the warmer portions of the country, have been touched, but not yet explored; Arabian date regions have been visited and their possibilities exploited; South America have been given a short visit of reconnaissance; and East Africa, Cape Colony, and the Transvaal, Sweden, and Finland have been visited but not explored. The almost unlimited plant resources of the Chinese kingdom are being probed by a trained agricultural explorer, Mr. Frank N. Myer. Hosts of things are coming in from his explorations that we are not yet in a position to talk about, since few of them have left the cool chambers in which they will remain until planting time, in the spring. Hardier persimmons and peaches from the orginial home of the peach, interesting new grapes, luscious Chinese pears, and hardy bamboos are on the long list of things already *en route* to America.

A glance at the great plant industries of this country shows that they have nearly all of them been influenced in the past, and are still being changed and bettered by the introduction of new plants.

THE DURUM WHEAT INDUSTRY.

The durum wheat, from which the bread of the common people is made in Southern Europe and Russia, was almost an unknown thing on our grain markets

until 1900; but to-day it is a living question in the milling centres of the north-west. It is a wheat for the dry lands, where the ordinary kinds grow poorly or not at all, and it yields so much more per acre, and is so much sure a crop that, even if it should not bring the highest prices, it will pay better than the less drouth-resistant species which Western farmers have hitherto tried to grow on the dry farm lands of the Dakotas and Nebraska.

Custom still fights the innovation of a new flour, and there are people who think our bread is in danger of being deteriorated by the new introduction; but they are not the well-informed who have tasted the full-flavoured durum wheat breads of Spain or Italy who realize the great and growing future of macaroni as a food in this country. American-made macaroni, prepared with the best of the old American wheats, cannot be compared with the delicate product of a Gragnano factory. But with the culture of this durum wheat in America a change is coming, and the time may come when we shall ship macaroni to Italy instead of importing it at the rate of nearly $2,600,000 worth a year. This innovation in the great wheat industry has been the results of the efforts of Mr. M. A. Carleton, who was sent to Russia as an agricultural explorer of the Office of Plant Introduction in 1898 and 1900. The office has distributed thousands of bushels of the durum wheat varieties gathered by him from all the Mediterranean and South Russian countries where it is grown.

THE SMYRNA FIG.

One of the most fascinating events in the history of plant introduction was the introduction of the Smyrna fig industry. The Smyrna fig has always been considered the finest fig in the world, and beyond all competition; so it was natural that progressive Californians should wish to see if they could not grow it. Orchards were accordingly started in 1880. They grew well, but the crops of fruit they bore fell to the ground when quite green, and it was evident that something was lacking to make the industry a success. A study of fig culture in Smyrna was made, and it was discovered that a process called caprification was necessary. This consisted in hanging in the trees of the true Smyrna fig the young fruits of another variety of figs that are not edible, but which contain thousands of microscopic wasp-like insects, called *Blastophaga*. These insects creep out of the caprifigs just at the time when the Smyrna figs are in bloom, and, crawling into the latter, they fertilize the hundreds of small flowers of which the fig is composed, and, instead of dropping off like unfertilized flowers, the Smyrna figs grow and ripen.

The caprifigs were accordingly imported as cuttings, but again the owner was disappointed when the trees bore, for it was discovered that they had left their tiny insects behind and were worthless. A final attempt was made through the combined efforts of the entomologist of the Department of Agriculture and Mr. W. T. Swingle, of the Bureau of Plant Industry, and, in 1899, after nineteen years of effort, Mr. Roding's orchard of Smyrna figs was established. It is still the largest in this country and has been yielding large crops of delicious fruit. Sixty-five tons was the output for 1903, and though in its infancy the California Smyrna fig industry is already supplying a portion of the fig now sold in our markets, and these are being put up with a cleanliness unknown in their native land.

JAPANESE RICE.

History tells us that the first rice in this country was introduced into the Carolinas in 1695 by the captain of a brig from Madagascar, who gave some seed to Governor Smith and his friends to experiment with, and the result has been an important industry. The rices which chance introduction had brought in were looked upon as the finest in quality in the world and were exported to Europe; but, with the call for a white and a more polished product than the hand-threshed rice of plantation days, came machine-polished rice, and the centre of the rice industry was transferred to Louisiana and Texas by the discovery of artesian wells in those States. The machine-polished rice that we buy in this country to-day is, as every one knows, a truly beautiful thing to look at, but as tasteless as the paste that a paperhanger brushes on his rolls of wall paper. The leather rollers of the machine not only rub off all the fine outer layer of nutritious matter, and with it the part that gives flavour to the kernels, but they often break the long, slender grains that characterize the famous Carolina golden rice. This breakage is so great that the Louisiana growers begged for assistance, and the new Office of Plant Introduction sent Dr. S. A. Knapp to Japan in search of a short-kerneled variety that would not break in the milling process. To-day Dr. Knapp declares that one-half of all the rice grown in Louisiana and Texas is the Kiushu rice that had its origin in the introduction made in 1899. This new rice has reduced the breakage from 40 per cent. to 10 per cent., and has at the

same time brought into culture a more productive rice. It has not done away with the pernicious practice of polishing, but an interest in the unpolished rice has lately been aroused that, it is hoped, will lead to the abandonment of a practice which robs the buyer of nearly all of the flavouring matter of the rice and leaves only the starchy portion. It is a disgrace that the most intelligent nation in the world should be so ignorant of the food value of the crop, on which more people live than on any other, that they should insist upon having their rice made as shiny as polished glass beads, although in so doing they are throwing away the best part of it. No rice-eating people treat their rice as we do, and it is to be hoped that the small markets that have been started for the unpolished rice in this city and elsewhere will lead to a general propaganda in its favour.

THE CORSICAN CITRON INDUSTRY.

The Corsican citron is better known to housewives than to the general public, though a failure to put thin shavings of candied citron rind into the poundcake would be quickly noticed by the household.

Though no one person eats in a year any large amount of citron, yet every one eats a little, and the aggregate amounts to over 2,000,000 pounds a year, almost all of which is imported from Italy and Corsica. To assist a progressive Californian who thought he had the right kind of land and a climate in which to grow the Corsican citron, the writer was sent to the birthplace of Napoleon by the promologist of the department in 1894. It was the first time I had ever tried to get from a foreign people the plants with which to start an industry that would eventually remove one of its best buyers from the field, and might some time lead to the apperance of a rival industry. I was nervous and had been advised that the Corsicans were not inclined to let scions of their fine citron trees go out of the country; so on landing at Bastia, the port nearest Italy, I pushed through to the centre of the Island; and there, in a small mountain town perched on one of the characteristic pinnacles of land, surrounded by groves of citrons, I made my mission known to the Mayor.

While awaiting for him to bury one of his friends in a neighbouring village, I strolled about the place and sought by means of my camera to dispel the suspicions of the crowd that gathered uncomfortably about me. While I stood with my head under the black focussing cloth, with a young mother and a child posing against the stucco wall before me, I was startled by the touch—not too gentle, either—of the *guarde civile* of the village. "*Vos papiers, s'il vous plait,*" was the curt demand. I replied in Italian that I had left them at Bastia, at which response, and to the evident delight of the crowd, I was marched off to jail. On an errand that was not likely to be pleasing if explained to the guard, with no papers in my pocket, with a captor whose very look was enough to terrify any one, and in a jail that would rival in filthiness any that the Inquisition ever had, I think there are few men who would not have paled. Seated in the jail, with the guard and his wicked-looking wife glaring at me, I was asked to give an account of the reason of my visit. This I refused to do, but endeavoured to find out why an American was arrested for taking pictures of the beauties of this lovely village. To my surprise, I found that I was taken for an Italian spy, and the examination of all my belongings only served to increase the suspicion, for it revealed Italian notes on abstruse botanical subjects. For hours I fought in poor Italian for a release, but not until I found, in a pocket that had been overlooked, a Treasury cheque for some small amount, and insisted that this was my paper of citizenship, did the guard reluctantly let me go, and I left the town as quickly as I could, cutting from some citron trees as I went, however, enough scions or bud sticks to graft a small orchard.

It was my pleasure, ten years after this, to visit in Southern California the orchard that was the result of the introduction of these scions. The industry is on a paying basis to-day, and Dr. Westlake, of Duarte, has his own factory in which he candies a grade of citron that he claims is more digestible than any now sold on our markets.

UDO, A NEW JAPANESE SALAD PLANT.

While there is nothing that has been found yet that will compare with lettuce as a salad plant, the Japanese have a vegetable that will give a welcome variety. In Japan it is as common as celery is with us, and is so popular that it is canned and sent to this country for the use of the thousands of Japanese who live here. It is used cooked with Soy sauce and in many other ways, yet it might never have been introduced into America but for the fact that a young American girl, Miss Fanny Eldredge, adopted the thick, blanched shoots, two feet long or more, as a salad. By shaving them into long, thin shavings, and serving with a French dressing, she pro-

duced a salad with a distinct flavour of its own, a crispness that was unusual, and a pretty silvery appearance. It was found to be a most vigorous grower, resembling a soft wooded shrub more than anything. The methods of its culture were worked out, and seeds were obtained and distributed to hundreds of private experimenters scattered from Nova Scotia to California and from Maine to Florida, and the result has been that shoots suitable for the table have been produced in a dozen places, chiefly on the Atlantic coast. It has grown almost if not quite as well in Washington as in Japan, and has shown itself a heavy yielder. Seedlings have in one year produced astonishing masses of roots, from which quantities of the blanched shoots have been grown in a dark chamber or under a mound of earth.

THE TROPICAL MANGO.

Many people think they know what mangoes taste like, because they have eaten some fruit by that name sold in one of the fruit stores of our cities. The fruits that are offered now as mangoes are unworthy the name, for they are from worthless seedling trees and are little more than juicy balls of fibres saturated in turpentine, while the oriental mango is a fruit fit to set before a king. It is in fact more richly flavored than a peach and has no more fibre. The trees grow on poor soil and attain an extreme old age. They bear enormous crops of fruit that make the trees look when in full bearing as though they were covered with a mass of gold.

The first introduction of the East Indian Mulgoba mango was made into Florida by the Office of Pomology in 1889. From the one tree of the early introduction which survived the freeze of 1895 has come the new mango craze that is now at its height among the Florida planters who have suitable soil and no frosts or only slight ones. When this tree, saved from destruction by Professor Elbridge Gale, of Mangonia, came into fruit it was a revelation to America—to the Western Tropics in fact. From this one tree thousands of grafted trees are now growing in Florida, and it will not be long before the mulgoba is for sale on our markets. To meet the demand for the best mangoes in the world, the office has brought young plants of the best varieties from every region where they are grown, and there is now assembled in the green-houses of the department the largest and the best selected collection of mangoes in the world. These are being fruited in Florida, and the best will be propagated as rapidly as possible for distribution.

SPANISH HARD-SHELLED ALMONDS.

The Sierras of south-eastern Spain produce most of the long, slender kernelled almonds which have come so rapidly into favour for salted almonds. California could produce tnem, as she already grows the poorest kinds, the soft-shelled, coarser-flavoured sorts. To get these finer kinds—the famous *Jordan* especially—the writer explored the almond orchards of Malaga and Andalusia, and cut scions or grafting wood from the best trees; much of this material has been used in California with success, but the *Jordan* flowers too early, and another expedition must be made in search of later flowering kinds from the same region to make the hard-shelled type a success, or else new regions must be found in this country where the *Jordan* will not be caught by the late spring frosts.

BERSEEM, THE EGYPTIAN CLOVER.

The greatest annual irrigated forage crop for culture in regions with mild winters is the berseem of the Nile Valley. It is the crop that the Egyptian *fellah*, or peasant, has depended upon for centuries as a soil improver and as a plant on which to pasture his cattle and other animals of the farm. Planted in the late autumn, it grows so rapidly that before the next June it will yield four cuttings of a most nutritious fodder that may be pastured upon, fed green, or made into hay. No other plant known should be so well suited to grow in those newly-opened up, irrigated regions of Arizona and California whenever the settlers learn to grow high-priced annual crops instead of alfalfa, which is the main plant industry in that region now. Berseem will not come into competition with alfalfa, for it is an annual, while alfalfa is a perennial, and therefore not suited to grow in rotation with crops like cotton, melons, or other annuals. The trials so far made with berseem are encouraging, and the plant has seeded at various places in California, and acre plots of it have been grown.

THE DATE PALM INDUSTRY.

The transfer from the great deserts of the old world to those of the new of the unique date industry is an accomplishment of which the Government may well be proud. It is something that private enterprise would not have undertaken for decades to come, and the name of Mr. Walter T. Swingle will be always associated with this new industry. Though the attention of the public was first attracted to the possibilities of growing the foreign date palm in this country through chance seedlings that bore fruit, and through an early intro-

duction of the pomologist of the department, it was the exploration trip of Mr. Swingle to the Desert of Sahara in 1899 that first proved the feasibility of starting commercial date plantations in Arizona and California. From the time when the first large shipment of palm suckers reached the south-west until the present, the Office of Plant Introduction has had an explorer in some one or other of the great date regions of the old world, gathering plants for the Government Plantations. To-day the list of introduced varieties numbers over 170, and more than 3,000 palms, large and small, have been imported and planted out. The best sorts from the Egyptian oases, selected kinds from the valley of the Tigris, the famous dates of southern Tunis, and even the varieties from uncivilised Baluchistan, have been gathered into what can proudly be called the best collection of date varieties in the world. This search through the deserts of the world has revealed the fact that the dates of our markets are only one or two kinds of the host of sorts known to the true date eaters, the Arabs, and that those we prize as delicacies are by no means looked upon by the desert-dwellers as their best. The search has brought to light as well the hard, dry date, which Americans do not know at all, and which they will learn to appreciate as food, just as the Arab has. Already, Egyptian and Algerian imported palms have borne and ripened fruit, and many persons in close touch and sympathy with the work have sampled the fruits of the newly-introduced industry.

To all of us who have seen the date palm forests of the old world deserts, and who have followed the progress of the experiments in this country, the landscape of the deserts of Arizona and California will not long be thought of without the presence of these stately plants that have so much that is biblical and ancient about them.

THE CAROB TREE OR ST. JOHN'S BREAD.

No tree of the Mediterranean region is more beautiful than the Italian carubo, the carob or St. John's bread of the English. In Sicily it is under its shade that the tired tourist stops to rest, and in Spain it is the orchards of the algaroba that attract his attention by their dark green foliage and picturesque form. Few realize that this tree is seldom planted for its shade or for its landscape effect, but for its pods.

These are borne in profusion and are most highly prized as fodder. There are carob-sellers in Spain, just as there are barley-buyers here, and these sellers export their carobs to this country in large quantities. The thick brown pods are full of a sweet honey-like fluid that runs out if you break them open. Cattle and horses are exceedingly fond of them, and children eat them, too, even in this land of cheap candies. Their nutritive value is high, so high in fact that a Wisconsin manufacturer makes one of the best calf foods on the market out of them.

The carob has already found a home in our West, and there are fruiting trees near Los Angelos to prove that it has come to stay.

EGYPTIAN COTTON INTRODUCTION.

America is the greatest cotton-producing country in the world, but nevertheless over 112,000 bales of cotton were imported from Egypt in 1899. There are distinctly different kinds of this great staple, and the Egyptian cotton supplies a different demand from the so-called upland cotton of this country. It is a variety with a long, very silky and crinkly fibre of a light brown color, and has been found better than the upland for the manufacture of stockings and underwear, and for mixing with silk. It is not the equal of the Sea Island cotton that is grown on the islands off the Atlantic coast, but the area in which the Sea Island varieties can be grown is very limited and the supply disposed of at fancy prices. It was thought that the Egyptian cotton might be successfully grown in the South, and numerous attempts to introduce it have been made by the Department; but while the plants grew well, they proved poor yielders, and their culture has been abandoned, although Dr. H. J. Webber has since made a large quantity of hybrids between this Egyptian cotton and the upland sorts, and these are more promising.

In the great Colorado River valley, however, which is the American Egypt, and has its dry, mild climate, its irrigation systems, and its long growing season, the Egyptian cotton promises much. There fields of it have been grown that resemble in almost every way the great fields along the Nile, and with the rapid increase in population that is taking place along the Colorado River will come the demand for this, the great money-making crop of Egypt.

ALFALFAS FROM TURKESTAN AND ARABIA.

From many standpoints alfalfa is the greatest forage crop in the world, and when its immense money value is considered the importance of a better variety, that costs no more to grow than the ordinary one, becomes apparent.

It found its way into this country probably from Asia Minor or Arabia through the round-about way of Chile. Since its introduction by the Friars in

the fifties, its culture has spread, until the area covered by it is over 2,000,000 acres.

With the thought that there was no reason why this Chilean alfalfa should be the best in the world, Mr. N. E. Hansen, the first explorer of the office, brought home with him seeds of alfalfa which he found on his exploring trip to the steppes of Siberian and Russian Turkestan.

It is only grown there in small patches, that are cut with sickles in a most primitive fashion. Distributed in large amounts, this seed has proven to be of a variety more resistant to drouth and alkali than the ordinary kind, and it is now being grown in acre areas in many parts of the West. While in Arabia three years ago the writer found and imported seed of an alfalfa which the Arab date-growers cultivate, and this has made such an unusual growth in the irrigated regions of the south-west that the farmers think they can get an extra cutting of hay from it each season.

THE MALIN HORSERADISH FROM BOHEMIA.

Horseradish culture in this country has been generally neglected. Until the introduction by the Office of Plant Introduction of the famous Malin horseradish, only one sort, the common American, was known. In a little village near Vienna the best horseradish in the world is grown. There are two or more other sorts that are recognized in the markets of Europe, but although sold as larger roots, these are not so fine flavoured nor so crisp as the *Maliner Kren*, as it is called. The methods of the Malin peasants, too, are superior to those practised in America, and it was thought at one time that to this difference in method of cultivation rather than to the variety itself was to be attributed its superiority. The introduction of the Malin roots, however, has proven that it is a superior kind. In New Jersey, at Edgewater Park, one of the first men to get the roots grew over six acres this season. Though he had on the same kind of soil, and adjoining the plant where he cultivated the Malin, the American sort, it yielded a ton of roots more than the native kind, was several weeks earlier in coming to maturity, thus commanding a higher figure in the early season, and produced a larger, more regular root. These favourable characters combined have made the Malin horseradish a much better paying one than any other, netting the planter $100 an acre more than the American.

This is a small industry, it is true, but in a single country in that State it has grown from the production of a few hundred pounds a year to that of more than 1,000,000, which means a decided increase in five years in the earning power of a community.

THE MANGOSTEEN FROM THE MALAY ARCHIPELAGO.

There is not in the whole range of fruits a single one that surpasses the tropical mangosteen in delicate flavour or in beauty; and yet, because the West Indies do not grow it, Americans who stay at home cannot taste it. Trees, few in number, it is true, are now grown in Jamaica, Trinidad, and even in Hawaii, but the propaganda in its favour has not yet been made, and we are now pushing an investigation to establish it as a new industry in Porto Rico, Hawaii, and on the Panama Canal Zone. The mangosteen has a poor root system, and it is one of the lines of research we are following to find among the near relatives of the species a form that has better roots and will serve as a stock upon which to graft the more delicate mangosteen. The genus to which this wonderful fruit belongs has at least fifteen edible species in it, few, if any, being known to those who have not made them a special study. It has a beautiful white fruit pulp, more delicate than that of a plum, and a flavour that is indescribably delicate and delicious, while its purple brown rind will distinguish it from all other fruits and make it bring fancy prices wherever it is offered for sale.

THE TUNA, A FRUIT AND FODDER PLANT FOR THE DESERTS.

The prickly pear, or tuna, is a fruit that all those who have been in Mexico or Italy, or who have visited southern Spain have seen and perhaps tasted. Few, probably, have thought that this fruit was the product of a cactus that would grow in the dry deserts where scarcely anything else will live, and produce fruit on which men can live. It furnishes a fodder for cattle, too, that though not of the best, is at least good enough to make it worth while to cultivate it in the old world, and in the new it has been utilized by burning off the sharp spine native in Mexico, but introduced into the Mediterranean region and into South Africa at a very early date, it has developed astonishingly there, and it is from these parts of the world and from Mexico that we are getting for Mr. Griffiths, the opuntia expert of the Department, all the different varieties. These he is growing in special gardens in California, and it is safe to say that he has already assembled there the largest collections of these plants of the world.

The newspapers have quoted Mr. Luther Burbank as claiming to be the originator of the spineless cactus. I do not think that he claims this, but he does think that the so-called spineless forms that the Office of Plant Introduction has brought in are not perfectly spineless, and that he can by breeding and selection remove every vestige of the long spines, and also the almost microscopic spicules that are even more objectionable than the spines, or at least quite as much so.

What some of the possibilities of the opuntia are Mr. Spillman, of the Department, has described in a lecture before this Society. The situation is one of the most fascinating in the whole range of plant breeding. Here is a tremendously variable desert plant that can be grown where other plants die; one that can be grown from cuttings as easily as a begonia; one that yields enormons crops of a fruit that is so nutritious that in Tunis, Morocco, and South Africa the natives live on it for months at a time. Though it is so full of seeds that the American fails to appreciate it, it is a fruit of which there are in existence almost entirely seedless varieties from which superior seedless forms can be made; a plant the joints of which are already used for fodder by burning off the spines, making it of value even in the wild state, and of which there are nearly spineless forms now in cultivation in Tunis, Aregentina, and Southern Spain. Add to this the fact that it is a tremendously rapid grower when given water, and that practically nothing has been done to improve it, and the great possibilities of the plant become apparent.

THE CHAYOTE, A NEGLECTED WINTER VEGETABLE.

Unless assisted, it takes a long time for even good vegetables to become popular. If one could patent them and control the supply, men would take these new things up and push them, just as they have new breakfast foods, of which they can control the processes. But a new vegetable! What man of moderate means wants to spend all the time and money necessary to advertise it, only to find that his neighbour has waited for a market, and when such has been created has gone into the culture of the new vegetable on a big scale and is underselling him?

The chayote is one of many such neglected opportunities. It is a cucumber-like vegetable, borne on a vine which can be trained over a trellis just like a grape-vine. It bears large crops of fruit, as many as 500 to the vine. It is a perennial and does not have to be planted every year, as the cucumber does, but goes on for years producing larger and larger crops. The fruit keeps excellently, and as late as March can be sent to the northern markets. Its roots are edible, its young stems as tender as asparagus, while its fruils can be prepared in twenty ways or more. The plant adapts itself to culture under glass and bears fruits there, even in the North, though its natural home is in the West Indies, and it will not be a profitable outdoor culture north of the Carolinas.

With all these points in its favour, which were first called to the attention of the American public by Mr. O. F. Cook in a bulletin of the Department, and with the further fact that it has been for years a favourite vegetable among the creoles of New Orleans, there are to-day none of these vegetables to be had on our northern markets.

To bring its good points to the attention of those who are looking for new things, the writer introduced it to Managers Hilliard and Macormick, of the Waldorf-Astoria, and the Bellevue-Stratford hotels. These men, whose business it is to cater to the jaded appetites of the rich, have pronounced it an excellent thing, have invented new recipes for cooking it, and have put it for the first time on their menus.

If a small demand is once created in our great cities for this new vegetable, that tastes like a combination of a delicate cucumber and a squash, with more firmness than either, there will be created a new industry for the South that will grow as the tomato industry has grown and support people by its yearly earnings.

PLANT PROBLEMS NOW IN PROCESS OF SOLUTION.

The work of Plant Introduction is not theoretical, but practical in character. Its operations are carried on in those places where it is needed, and the problems are suggested by practical men. Some of the problems which the Department is now working on are: the finding of paying crops for the abandoned rice farms of the Carolinas; the securing of some profitable plant culture for the unemployed hilly regions of North Carolina and Georgia; the improvement of the brewing barleys of the country; the fitting in of new crops into the arctic agriculture of Alaska; the starting of new industries in our tropical possessions; the increasing of the fertility of the California orchard soils; the intro-

ducing of hardy fruits into the Northwest; the substituting of a valuable for a worthless cane in the cane brakes of the South; and the exploiting of a drouth-resistant nut plant for California.

The planters of the Carolinas must have a new crop to grow on the rich rice lands that are no longer profitable for rice culture since the great Louisiana and Texas rice fields have been opened up. The Office of Plant Introduction has suggested the trial of the Japanese matting rush as likely to be a profitable one on these areas; and is planting thousands of seedlings of the plant, and watching them carefully to see how expensive their cultivation will be. It is also experimenting with a new root crop on the cheap sandy lands of the region as a possible substitute for the Irish potato, which will not grow on that soil.

There are also thousands of unemployed acres of hilly lands in the Carolinas where the conditions are good for the culture of the Japanese plant from which the finest writing paper in the world is made, and the Office has introduced and planted there thousands of these plants to see if they will not develop into an industry which will utilize these great waste areas.

The barley growers of the country are growing millions of bushels of grain for the brewers, but among the hosts of so-called varieties that are recognized on the grain markets not one is a pure race or breed. The Swedes have long since found the use of pure barleys of great advantage to the brewers, and their plant-breeders have created pure types. The Department has imported these, and they are now on extensive trial by the best barley-growers in the country.

Alaska, with its cool, short summers and extremely cold, long winters offers new problems for Plant Introduction. The crops cultivated by the farmers of the great plains are accustomed to a long, hot summer, and when tried in Alaska they are caught by the early autumn frosts before they are half ripe. To meet these new conditions, Norway, Sweden, and Finland have been drawn upon for grains and vegetables, and the most successsful oats grown in Alaska to-day are the Finnish black oats that were introduced by the Office of Plant Introduction.

For the tropical regions of Porto Rico, Hawaii, the Philippines, and the Panama Canal Zone, there are hosts of new possibilities open. The sisal fibre importations from Mexico costs this country over $16,000,000 a year, and we propose to demonstrate on a practical scale that the sisal plant will grow in Porto Rico and supply a share, at least, of the thousands of miles of binding twine which the Western farmers use in their harvest fields.

There are a host of new fruits which are common in the oriental tropics and which would quickly win their way to popular favour on our markets, waiting to be brought in and made into thriving industries. To run-down coffee varieties need new strains to invigorate them, and it is a possibility that the wild coffees of Abyssinia which Consul Skinner has secured for the Department will bring this about. There are new root crops like the taro, the yantia, and the tropical yam that are almost unexplored, so far as their possibilities as food for the white man are concerned, and whose excellent qualities and remarkable yields put them in the same rank with the potato.

THE CURIOUS PROPERTIES OF THE FENUGREEK.

The great fruit-growers of the Pacific slope, with their thousands of acres of clean tilled orchards, have been searching for a cover crop that would increase the fertility of their lands and add the necessary humus or vegetable matter to it. We have found this for them in the shape of leguminous plant that inhabits the Mediterranean region—the fenugreek. The seeds of this plant, curiously enough, are eaten by the Jewish women of Tunis in order to make them fat, and no young Jew in that region could think of marrying a girl until the use of this grain had increased her weight to the fashionable figure of 250 or 300 pounds. The seeds form a part of the expensive condition powders that stock-men use to prepare their stock for the fat-stock shows, and it was for this purpose that our explorers introduced it in the first place.

For the great North-west, where fruit trees are killed every winter and none but the hardiest kinds will grow, the explorers have brought in from Russia the hardy Vladimir cherry and forms of the Siberian crab apple, with the hope of at least starting some types of fruit that will be hardy there.

The "cane breaks" of the Southern States are thickest of an American bamboo whose stems are so brittle that they are worthless in arts. Shipments of the Japanese timber bamboo, from which the thousand and one beautiful Japanese things are made, have been imported and are being tried in those areas to see

if they will not grow there and occupy land that to-day is the ranging ground of wild-hogs and half-wild cattle.

A DROUTH-RESISTANT NUT.

Thousands of acres of almond orchards in California have been unprofitable because the rainfall is too light in the regions where the orchards have been started; and to get a more drouth-retistant nut plant for these areas the pistache from the Levant has been brought in, and there are now being set out at various places in California small pistache orchards, the pioneers of the new pistache industry, that will some day make this delicious nut as common as the almond is, not as a colouring and flavouring material for ice creams, but as a nut for the table, to serve as salted almonds are now. Mr. Swingle, the enthusiastic introductor of this nut, has searched throughout the world for all the pistache species that can be found, some to use as stocks and others to breed from, and there is every prospect that he will succeed in introducing into the arid regions of the South-west an entirely new nut industry.

These are some of the many problems that the Government enterprise of Plant Introduction is engaged in solving.

They are problems that private enterprise will not naturally undertake; they are problems that concern the wealth-producing power of American soil; they are problems that the Government has shown its ability to solve in a manner involving an insignificant outlay of the public funds. They encouraged the production of food and other products that we now import from other lands, and they concern the establishment of farm industries which, for generations to come, will support hundreds of thousands, perhaps millions, of American citizens.—*The National Geographic Magazine*, *Washington*, Vol. XVII., No. 4, April, 1906.

[This is the only satisfactory way of plant introduction now-a-days. All the "obvious" introductions have been made, and it is the work of a travelling specialist to find new things in appreciable quantity.—ED.]

THE POSSIBILITIES BEFORE THE AGRICULTURAL SOCIETY: ITS BOARD, AND BRANCH ASSOCIATIONS, IF JUDICIOUSLY WORKED.

(Paper read by the Hon. Mr. J. Ferguson, C.M.G., at the Meeting of the Board of Agriculture on 9th March, 1908.)

1. AGRICULTURAL COMMISSION OF 1899.—In 1899 H.E. Sir West Ridgeway appointed a Commission, under the presidency of Mr. Justice Laurie, to enquire into, and report on, the advisability of establishing a Department of Agriculture. The Chairman and a minority of members reported in favour of the establishment of such a Department and the appointment of a Director of Agriculture, to be assisted by an Advisory Board. The majority, including all the Ceylonese members, Dr. Willis and Mr. A. F. Broun, Conservator of Forests, were opposed to a new Department, and favoured the appointment of a Board of Agriculture, with a member of the Executive Council as Chairman to be in close touch with all the Government Agents and Assistant Government Agents, as well as the staff at Peradeniya. In favour of the establishment of a Central Agricultural Board with Branch Provincial Boards, all to be assisted with scientific advice (in preference to an Agricultural Department and Director of Agriculture), very strong opinions were expressed in 1899 by such experienced Government Agents as the late Messrs. F. C. Fisher, H. Wace, Allanson Bailey, R. W. Ievers, and Messrs. Evan Byrde, G. A. Baumgartner and G. M. Fowler.

2. THE STARTING OF THE AGRICULTURAL SOCIETY.—Nothing was done until, on the 17th October, 1904, the Ceylon Agricultural Society was founded by Sir Henry Blake, and a Board of Agriculture formed on a very wide official and unofficial basis. I need not refer to the past working of this Board further than to say that, in my opinion, a great mistake was made when organising Branch Societies in the different provinces and districts, in not putting the same under the direct control, as Presidents, of the several Government Agents and Assistant Government Agents. It is when these officials have taken an active interest—as in the Badulla, the Trincomalie, the Vavuniya and Mullaittivu, the Colombo, Kegalle, Matale and Nuwara Eliya branches—that most benefit has been secured through the working of the Society.

3. WHY A CENTRAL BOARD IS NECESSARY.—It may be asked, if this is the case, why there should be a Central Board (or a Society) at all when the Revenue Officers could carry on agricultural improvements with the direct sanction and aid of the Executive Government. To answer this I have only to mention what was made abundantly clear by the Commission of 1899—that the great drawback to agricultural improvement in the native districts during the past century has been the want of continuity, the want of some one Central Board and officers to take cognizance of what has been begun in each district, and to see that if Experimental Gardens, Agri-Horticultural Exhibitions, Garden Produce Shows, headmen's or leading residents' gardens with experiments in new products—pepper, cacao, tobacco, etc.—are once introduced, the same should, if at all possible, be continuously or permanently carried on, or good reasons given why any such experiments should be dropped. It was shown, for instance, that often, through the interest of a particular District Revenue Officer, a start had been made with a new product or industry, or an old industry had been revived and improved—and how considerable progress had been made—during five or six years of a particular local administration through the Agents' or their Assistants' influence over, and pressure upon, headmen and cultivators. But that, when a successor came with no taste for agricultural improvements, the experiments get neglected and the progress was lost. Promising Experimental Gardens have been begun, in which, if accompanied by periodical district Shows and all duly reported on and recorded in the annals of a Central Board, there would be some hope for continuity; but in not a few cases these have been abandoned. An experienced Bevenue officer has said to me in years gone by: "Our stations are full of the neglected sites where one Revenue Officer started an experiment in new products or a regular Experimental Garden and his successor let it die out." The existence of judiciously managed Local Branches of a Central Agricultural Board are calculated to counteract such want of continuity; and not only so, but to secure some measure of uniformity all over the Island in respect of agricultural improvements, through the publicity given to periodical or special reports, and the notice taken of the same from time to time at the Board meetings. If ever a spirit of emulation in agricultural improvement and progress is to be fostered among the District Headmen or leading agriculturists in the native districts, it must be through an agency of this kind.

4. AGRI-HORTICULTURAL SHOWS.—Take the one item of Agri-Horticultural or Produce Shows, and if a Board of Agriculture and its Branches did nothing else but secure the systematic establishment of such Shows throughout the different provinces and districts, it would, in my opinion, be doing a notable work which could not fail to tell on the agricultural enlightenment and advancement of the people. Not only so, but such district gatherings and Shows should provide a subject of general interest and even amusement to the people. The British Government in Ceylon, as has frequently been remarked, has done far too little to encourage sports and pastimes of an innocent nature among its native subjects, and, as a consequence, "to have a case in Court" and to dance attendance once a month, or once a quarter, at the nearest judicial court has been regarded by families and villagers as the nearest official provision afforded them for a holiday. One of the most successful Agri-Horticultural gatherings ever arranged in Ceylon was by the late Mr. Baumgartner at Matara in 1889 where, following on the Show of Products and Stock and the distribution of prizes, there came a series of native as well as Western games with due rewards to winners which, with the medals, money and certificates for produce prizes, sent the country-folk back to their villages far better contented with their rulers and themselves than probably they had ever been before. The chief provincial capitals and minor stations should each have such a Show and holiday time once a year, if possible, or neighbouring districts might alternate; while the less populous districts could have Shows and gatherings on a more moderate scale. As to the advantage of these we can see what Government Agent Evan M. Byrde wrote from Anuradhapura Kachcheri on June 30, 1899:—"Since the inauguration of Garden Products Shows in this Province, the improvement in the growth of fruit and vegetables is very marked, and now what is needed is fresh stocks of seed and an established Board of Agriculture to keep up the interest in this useful work. I may add that during this month I have held three Garden Products Shows in the Province, and the result far exceeded my expectations; in fact, all who attended these shows, including even the villagers, expressed astonishment at the large number of exhibitors and exhibits, and in very many cases the exhibits were very good indeed." This is sufficient proof of what

can be done with the help of chiefs and headmen, and some encouragement to the people by the distribution of seed and of suitable prizes.

Mr. F. R. Ellis, when Government Agent for the Western Province, advocated Agri-Horticultural Shows to be regularly carried on as efficacious in promoting agricultural improvement, and that substantial aid should be given to local Committees. Other revenue officers (past and present) who have favoured the holding of Shows are:—Sir Chas. Layard, Sir Frederick Saunders, Messrs. Wace, Davidson, Le Mesurier, White, Bartlett, Bowes, Vaughan and Stevenson.

I see that Agricultural Societies and Agricultural Boards in other Colonies do all in their power to promote Agri-Horticultural Shows at all likely centres, and more especially is this the case in the West Indies and British Guiana. I would draw attention to the following extract from the Presidential Address of Sir Daniel Morris, K.C.M.G., before a recent West Indian Agricultural Congress:—"The best results are probably obtained where the Shows are held in the country districts, and not necessarily in the chief town of the Colony. By such means, the interests of cultivators in the out districts is enlisted, and the stimulating influence of the Shows is spread over a wider area. It is a matter of satisfaction to learn that some thirty Agri-Horticultural Shows and Fairs have been held in different parts of the Island since the inauguration of the Agricultural Society at the end of 1904; but I think there ought not be fewer than 15 to 18 each year, large or small, considering the number of revenue districts in the Island, and I think certainly that a portion of the funds granted by Government for the promotion of Agriculture cannot be better spent than in helping—where help is needed—to establish such Shows and to make them a success. At all such Shows, prizes—medals, or small sums of money—should be offered by the Society for competition, and I would also wish to see special annual recognition, in some suitable form, of the individual who, in all the Island, has done most in a practical way to further the objects of the Society in Agricultural progress or improvements. The further employment of good men as Agricultural Instructors, as is done in the West Indies, is very desirable. These men, if properly trained and instructed themselves, could do an immense amount of good to the native agriculturist as peripatetic agents of the Society in lecturing, conversing, explaining, enquiring and demonstrating as they go about the country.

5. JUDICIOUS GRANTS DESIRABLE.—Another judicious way of expending the grant of public money which the Society receives from Government should be for the Board to arrange for a supply of seeds and plants to the Kachcheries, Branch Societies, and Agricultural Schools, the Secretary obtaining the same periodically from the Botanical and Experimental Gardens and from other local and foreign sources. I would also strongly recommend that the Board have power to make small loans, in money or seed or plants, where good security is furnished, with the view of trying a new product, or one which is new in a certain district, though its success has been approved elsewhere.

6. PRIZES OR BONUSES FOR HOME INDUSTRIES.—This Board, if it is empowered to offer encouragement or aid to village pioneers on modern methods, by means of prizes or bonuses, can do much towards establishing home-indrstries that are flourishing in other parts of the tropical or sub-tropical world, and may this again be the means of superseding and preventing idleness that nearly always breeds mischief.

7. PEPPER AS A VILLAGE INDUSTRY.—The officers of the Dutch Government did all in their power to promote a great industry in pepepr-growing among the Sinhalese, and they were so successful in the Kegalla and Matara districts that the export of pepper was in Dutch times of more importance than that of coffee. I do not see why, with due continuous encouragement, the growing of pepper as a village industry should not be revived and greatly extended. There are other similar products which might be mentioned as indeed Dr. Willis has done from time to time. And in to-day's Progress Report mention is made of Cotton and Ground-nuts in a favourable light. Ground-nuts in four years have been cultivated to as much as 80,000 acres in Burmah. In 20 years in Natal the industry in Black Wattle (for tanning bark) introduced from Australia, has covered an area of 100,000 acres.

8. APICULTURE AND SERICULTURE FOR THE VILLAGERS.—In connection with bee-keeping and sericulture, prizes should be offered after a judicious fashion, to encourage the introduction of such new industries into certain districts. The example of the late Mudaliyar Jayatilleka, who was a very successful bee-keeper in Kurunegala, could surely be followed by other village headmen or unofficial district residents, under the stimulus of a Society's medal to be handed by H. E. the Governor. And just as lace-making in many villages and girls' schools has

become an important and profitable industry for hundreds if not thousands of families within, mainly, the past twenty years, so may, it be possible to make *Sericulture* a village industry, when once a fair start is made and its profitable results shown. The Agricultural Society has indented for a disintegrator and washing machine to treat cocoons of the Eri silk worms, and Mr. Jas. Whitehead, who is now at home has selected the machinery. This type of machine is used at home for treating "silk waste," which is utilised subsequently for spinning. The disintegrator and washing machinery will be able to deal with large quantities in a short time, and with its introduction offer better prices for Eri Cocoons and sericulture developed by the Society.

8*a*. PATRIOTISM AND PUBLIC SPIRIT.—I was reading the other day that in olden times in Southern India it was the custom for the local village or district "banker" to ease his conscience, and seek the blessings of posterity by lavish expenditure on the provisions of *water* and *shade* for the benefit of his village. The custom is said to have fallen into abeyance, through the State taking Sanitation, Forestry and Irrigation into its charge. But it is alleged that the motive, whether we call it public spirit or private charity, which inspired these "benevolences" is not dead, and if it could be brought forth once more into active operation, its effect on the promotion of agriculture might be of great importance. In Ceylon, leading village residents, landholders or headmen are generally ready to give themselves a great deal of trouble in trying proposals for improvement, or the introduction of new products, if they feel that constituted authority even through a Board of Agriculture, patronised and approved by Government, is ready suitably to recognise their efforts. Special medals of some value might be provided and awarded in exceptional cases.

9. MARKETS FOR PRODUCE AND STOCK.—Another way in which the Society can occupy itself usefully is by aiding Local Branches with information and assistance towards securing a regular and satisfactory market for their produce and stock. The efforts of Mr. Brayne, A.G.A., as Chairman of the Vavuniya Branch, in establishing a Co-operative Forwarding Agency for his district is a case in point. This provision of market—says Dr. Willis—is one of the most important duties that can come before a local agricultural society; established products—such as tea leaf, cacao-pods, rubber—can be sold to the nearest estate, not so with fruits, vegetables and live stock. In Jamaica the Board of Agriculture has inaugurated a Prize-holding Scheme which I find has only to a small extent been adopted locally (*e.g.*, Jaffna, Ambalangoda and Telijjawila) and might well be extended. I read that the scheme in Jamaica has proved to be of the greatest help to the Instructors in enforcing their lessons. The object is the encouragment of cultivation on homesteads, and takes the house and sanitary condition into account in the scale of points allowed. The progress is thus noted—permanent crops 30, catch crops 15, fences, gates and general conditions 15, live stock 20, house 10, sanitary condition 10. A great deal is also possible in the collection of suitable information from Europe, India and elsewhere, on all subjects likely to enhance the usefulness of the Society, a work which of course has already been in progress during the past three years.

10. CO-OPERATION.—The subject of Co-operative credit societies and loan banks, as worked in Europe, India and the West Indies, deserves to be fully studied and their practical application to local conditions thought out by members of the Board. So far, a beginning of co-operation in the matter of seed and manure supply has been reported in the Review of its work last year issued by the Society, but this has been limited to two or three local branches. It is much to be desired that the Board itself should take the initiative in this matter. To-day's Progress Report indicates a successful district experimental Co-operative Bank.

11. OFFICIAL SYMPATHY AND CO-OPERATION AS MUCH REQUIRED AS MONEY.—Government has made what may be considered a handsome annual grant to the Society, if it is properly utilised, and there is, I am told, a balance and no lack of funds at this time. But money is not everything. In the useful work that lies before it the Board requires the full sympathy of the Executive Government and the confidence and co-operation of Government servants of all grades, but most of all of the Revenue Officers in charge of the different Provinces and Districts of the Island.

SCHOOL GARDENS deserve the special support of the Society, as agencies for furthering the work of agricultural progress and improvement, and I am glad to find from published reports that during last two years the gardens already established have received a grant of prizes from the Society. I trust such grant will be made an annual one, and

every encouragement given to the work carried on under the School Garden Scheme. There are not a few other means of progress, which might, with advantage, be taken up by the Society through its advisers on this Board, but in the time and space at my disposal, it is not possible to deal fully with all that ought to be suggested.

12. USE OF BOARD MEETINGS IN PROMOTING A GOOD UNDERSTANDING AND STIMULATING INTEREST.—I may mention, however, before closing, that I personally attach great importance to the periodical meetings of this Board as a most useful means of bringing intelligent English-speaking Ceylonese Agriculturists, including Capitalists interested in some one branch of agriculture (a class that, with the spread of education, is rapidly increasing in Ceylon) and leading Government officials, face to face, and so permitting of an interchange of ideas and opinions on a subject of perennial importance to the material progress of the Colony. I was struck by a remark made only the other day by the new Governor of Bombay, Sir Sydenham Clarke, to the effect that "between the administrators and the intelligent portion of the population of India there was too much writing and not enough of personal contact." We have seen at our Board meetings, in the past, enterprising Ceylonese ready to improve with old, or to experiment with new, products, come from as far as Jaffna and Matale on the North and East, Galle and Matara in the South, to attend our meetings; and, were it only for the interest shown and the interchange of information afforded in respect of experiments in cotton and tobacco growing alone, I would say that the Society and its Board have not failed of their purpose. Several useful papers have been read by Ceylonese gentlemen from the country, and in illustration I may mention that on the "Citronella Industry of Ceylon" by Mr. Samaraweera of Weligama. But when in addition we think of all the many profitable papers read by Dr. Willis and other members of the Scientific staff, as well as by unofficial members, and all that has been done for the improvement of, and to find a market for, live stock, we may well feel that with such information circulated broad-cast not simply in English, but also in the vernaculars by means of the native press and leaflets, much good has been done, and seeds of knowledge and experience have been sown which are bound to bring forth a satisfactory crop in due season among a large number of agriculturists in Ceylon.

THE DISCUSSION.

MR. CLIFFORD ON THE POTENTIALITIES OF THE SOCIETY.

The Hon. Mr. CLIFFORD:—I should only be voicing the feelings of every member when I venture to thank Mr. Ferguson for the very interesting and suggestive paper which he has read. I think we all have very much at heart a desire to utilise the Society to the very best of its potentialities, and I do myself firmly believe it is capable of being utilised greatly to the benefit of the people of this Colony. My only doubt is as to the inherent vitality of the Society itself. I think, Sir, that it is regrettable that in a population which is numbered by millions, so very small a section of that population should be members of this Society. I think, Sir, that it is very regrettable that whereas the Government gives a grant of Rs. 30,000, our subscriptions only come to Rs. 8,000. I am not quarrlling with figures, but I take it that it is in some way symptomatic of the slackness I fear. In view of what Mr. Ferguson has suggested, we all know of the many potentialities for usefulness which this Society undoubtedly possesses. Every member of it should do his best to increase the membership, to preach the object for which the Society is created, to enlist the sympathy and enthusiasm of his friends in it, and to try to assist in instilling into it a vitality which will make it self-supporting, and not dependent upon the Government—I am not now referring to the Government grant—and having life of its own. On behalf of the Government I may assure the Society of every assistance, encouragement, and help and aid that Government can give. I think we all know the very old dictum that Heaven helps those who help themselves, but it is impossible to help the helpless beyond a certain point. If the Society is to do its work it should be dependent upon its own vitality and initiation, and not only through the support from Government. I most cordially endorse what Mr, Ferguson has said as to one of the many advantages of this Society, and that is the meetings which take place periodically. They enable many of us to come into contact with gentlemen who take an interest in the agriculture of the country, and who know far more about the various forms of agriculture than any of us. From these men we can naturally derive a great deal of enlightenment and advice. I, personally, very much appreciate the opportunities we have of hearing the views of gentlemen who undoubtedly

know this Colony, and who have much information to impart. In conclusion, I would once more ask the members present to-day to thank Mr. Ferguson for the very interesting paper he has read.

The Hon. Mr. BOOTH said, as an official he would like to say something, although the Colonial Secretary had expressed the thoughts he (the speaker) had in his mind more eloquently than he could express them. He spoke of the people as an inert mass which, when limbered up, fell back. The instance of the lace-makers was one where an industry was kept up without Government help. What they wanted was more life put into their institutions. The officials were willing to assist in every way possible, but everything could not be done by Government. There was too much in the country of looking up to Government as the father and the mother, not to speak of the grandmother, of the people.

H.E. THE PRESIDENT.

HIS EXCELLENCY:—I should like, personally, to thank Mr. Ferguson very much for the valuable paper he has just read. I may tell him it will be of the greatest assistance to me, personally, in considering the whole position of this Society. I have been giving the matter some attention during the time I have been here; but, naturally, I am still rather in the dark. Several points which Mr. Ferguson has mentioned have struck me, and nothing more so than what was said in the second paragraph, which Mr. Ferguson did not read. It was—

"I need not refer to the past working of this Board further than to say that, in my opinion, a great mistake was made when organising Branch Societies in the different provinces and districts, in not putting the same under the direct control, as Presidents, of the several Government Agents and Assistant Government Agents."

The remarks which have just fallen from the Government Agent of the Western Province are quite to the point. It is a fact that whereas a branch society will be under his control, it does not mean that he as Government Agent by being President is to do everything. The branch societies must work equally as well as the Government Agents, and if, for instance, the Government Agent does not attend a meeting, owing to other business, the branch societies under his general administration, and the general control he exercises, should be able to go along successfully the same as if he were present. I have been considering whether the Board of Agriculture, as distinct from the Agricultural Society, should not be more in touch with the Director of the Botanical Gardens, and through him with the Government Agents; whether in each province there should not be some definite programme laid down, and whether it would not be the business of the Government Agents and Assistant Government Agents to see that that programme is carried into effect. That is one point that has struck me, gentlemen. I am sure we all recognize that this Society is a mass of strong points, but it has got its weak points too; there is no use denying that, or, like the ostrich, hiding our heads in the sand, and think we are not seen. We have to tackle them, to look at them and face them. At present, there is not enough machinery, in the meantime, to bring us into close touch with our friend the *goiya*. To do that we want supervisors, and superintendents and instructors, men like my friend on the left, Mr. Drieberg here, who knows the natives thoroughly and who does his best for the good of the Society. (Applause.) We want more men like him. We want agricultural experts. That takes me to history. If we look at history, we find that of the Agricultural College not uninteresting. The work of it was defective simply because the students who went there did so because they thought that they could get Government employment—not Government employment in the agricultural line but in other lines. It was in consequence of that that the College came to an untimely end. Now we must have many more Agricultural Instructors, and we must think how to provide them. I have not studied the subject sufficiently yet, and I should like to know more about it before I decide anything. But you, gentlemen, would perhaps like to know the broad ideas I have at present on the subject. I have in view the idea of establishing training schools of agriculture, for if there is any one branch we want in technical education more than any other, it is instruction in agriculture. (Applause.) My idea is that training schools shall be established at our general botanical centres like Peradeniya, Hakgala and elsewhere. At these schools we shall encourage young men from all parts of the Island to attend. There should be a specified course of instruction, and young men of good family standing will attend these instruction classes with a view of their getting Government employment, but that Government employment will be agricultural; it will not be anything else. (Applause.) We can then extend the system of agricultural training to the school gardens;

those school farms will be converted into branch agricultural schools, so that gradually the elements of education in agriculture will spring up in the Colony, close to the people and at the door of the people. Every encouragement will be given by the Government to push forward cultivation, so that we may not only have enough for local consumption, but also possibly have an export trade such as that in pepper to which Mr. Ferguson has alluded in his paper. I only mention these broad points now so as to give you a broad idea of what has been recently passing through my mind. I am studying the subject, and you may depend upon it that I shall not fail to pay every attention to it, for I think that it is a subject of primary importance to this Colony. With these remarks I beg to thank Mr. Ferguson for the very able paper which he has just read. (Great applause.)

Mr. FERGUSON begged to thank H. E. the Governor, the Colonial Secretary and members of the Board for the cordial thanks accorded, and he ventured to say with how much pleasure he had listened to the very statesmanlike programme the Governor had shadowed forth for the future agricultural training of young Ceylonese.

APICULTURE.

RESCUING BEES.

By the Rev. J. G. Digges, m.a.,
Editor, "Irish Bee Journal."

In the Emerald Isle modern methods of beekeeping have made great headway within the past few years. But it cannot be said that the cruel, wasteful practices of old times have altogether disappeared. In some districts hives with movable combs are still unknown, skeps and grocers' boxes are the fashion in bee hives, hammer and tongs are brought to bear upon rising swarms; and when autumn comes the unfortunate queen and workers who have been strong and diligent enough to gather a weighty harvest of honey, are ruthlessly smothered in sulphur fumes. Not infrequently, when the reckless slayer of bees is told of a better way by which honey can be taken without destruction of the stocks, he sneers at these "new-fangled ideas," prefers to follow his own plan, and says, in effect—

"It was my father's custom,
And so it shall be mine."

Of course this antiquated custom of "taking up" the hives, preparatory to putting them down in the sulphur pit, has its advantages for beekeepers who are familiar with the process of "driving" bees from a full to an empty skep. They can often effect a purchase of condemned stocks at a shilling each; and if such stocks are taken early in autumn, and are united and well treated before winter sets in, they will generally give a good account of themselves in the following season. At the same time a practical lesson will have been offered to the skeppist who, having seen the ease with which the operation can be carried through, will be less likely to allow reverence for his "father's custom" to deprive him in future years, to the enrichment of his more enterprising neighbours.

It is the boast of modern bee-keeping that it follows humane principles. With the arrival of the season in which skeppists begin to plot the destruction of their stocks, I was pleased to receive from a priest in the west of Ireland the following description of his plan for upholding the credit of modern methods as against the barbarous custom referred to above. The letter and illustration may prove interesting to readers of the Studley College Agricultural Journal, and may encourage others to become rescuers of bees; for I think that even in Great Britain the horrors of the sulphur pit are not altogether unknown. He writes:—

"Of late I have been cleaning and burnishing up my hives, inside and outside. I am pleased to be able to say that the one that has stood the winter best, and looks like being my champion one for the summer, is that whose inmates I saved from dire destruction last autumn in the fashion suggested by the accompanying photograph. [Not reproduced.] It was an act of charity and of mercy, which, I will allow, is not to my discredit.

"These bees belong to an old-fashioned, conservative beekeeper, some half-a-dozen miles off. During the season they had laboured hard for him, and had gathered, he knew, far and away more honey than any of his four or five other stocks. He knew it by the weight of the skep, for he tore all of them up, getting, I am not a bit sorry to say, numberless splendid jags at each operation. And these poor doomed bees, his very best, were to have as their portion, in return for their toil and industry late and early in the long summer, and as a reward for their brave, well spent-lives—fire and brimstone!

"But we made a bargain. He got all he wanted—the honey, and what he liked—no trouble and no stings in the getting of it. I got the bees and the loan of a table-cloth and of an old skep, and a beautiful cup of tea, I must add, from 'herself,' into the bargain. In the driving from the honey-laden into the empty skep there was, of course, no difficulty. As well as I can remember, I was not stung once. Then I tied the skep on the back of the bicycle, behind the saddle, as shown; my black rain cloak fluttered over the linen tablecloth, making it less of a conspicuous circus display. Then up and off. The small boys did not remark it, in the grey of a fine autumn evening, when of all other times they are particularly *en evidence*. I sailed leisurely down the main street of the little town. The rescued bees I wintered on three frames loaded with capped honey, and I made them as comfortable as you please in their new quarters. They were out once more in the spring, buzzing about, long before the cuckoo or the corncrake.

"As to swarms, I have carried several in the same safe, if outlandish, fashion. Distance is no consideration. To the bicyclist just learning to ride—if in this twentieth century there be any such—the plan is hardly to be commended. To get on and off is something of a circus feat. Once on and away, they give no further bother. But they keep up a gentle murmur of approval, which soon lulls to forgetfulness, and on meeting a friend, and suddenly dismounting, or trying to, as usual, he is apt to 'come a

cropper.' For the practical and thoughtful wheelman it is a splendid plan. Any bicyclist bee-keeper that would let a lot of poor, hard-working bees within a radius of ten miles of him be consigned to fire and brimstone, and not rush to the rescue, is a poltroon and a savage, and would richly deserve a scent of the brimstone himself. The ten miles radius, and he in the centre, means over 300 square miles, and that area he should be able to guard against such rascality. Unless, indeed, there be an old curmudgeon beekeeper about, who would hardly talk to a body, it should be absolutely safe. But as no such individual ever did or ever does take kindly to beework—genuine apiary men are all fine fellows—the area mentioned, with a 'bee-man,' a halfpenny postcard, and a bicycle in the centre, and a tablecloth and an old skep anywhere about, should be as secure against dastardly bee-destruction as against a German invasion."—*Studley College Agricultural Journal*, Vol. II. No. 8, Sept. 1907.

APICULTURE IN CEYLON.

(2nd Series.)

BY AN AMATEUR.

(*Continued from page 208, Vol. XXIX.*)

I.

Having allowed a little time to elapse, during which, I hope, some of the lessons contained in my former papers may have sunk into the mind, I now propose to touch lightly on what we may call "higher apiculture." And I am going to begin at the very apex of the science, partly because it is deeply interesting, but chiefly because the sooner it is widely understood the more successful will the industry be in the Island. I refer to queen-rearing.

It should be borne in mind that, owing to the peculiar circumstances under which queens are mated, breeding by selection must (at any rate until man has contrived a means of controlling it) always be somewhat of an uncertainty. We can select the queen; but so far we are seldom able to select the drone with which she is to mate. I say seldom, because, by isolating the queen and drone (or rather, hive containing the selected drones) on an island removed by some distance from any land where bees already exist, we can say with certainty that that queen, when mated, has been fertilized by a drone out of the selected hive; and further, by the stongest flying drone of that hive. But there are few islands handy for such an experiment. Therefore, as a general rule, our attempts at selective breeding are at the mercy of our neighbours—to say nothing of the wild bees in the vicinity. It will thus be seen that the more we can insure our neighbours having good strains of bees, the more likelihood is there of our queens being mated with suitable drones.

So far as present observations go, fertility and energy in honey-gathering are inherited from the queen; while temper is derived from the drone. Since, therefore, we can choose our queens from our most prolific and energetic stocks, we can insure improvement on these two lines. But to most of us it is of the utmost importance to have quiet-tempered bees. And here we can insure little. Still, it will be to our advantage to increase the numbers of good-tempered stocks in our districts, as pointed out above. Therefore it will be to our advantage to give away queens to our neighbours whose progeny is known to be gentle.

Now, here we come to a point that should be remembered. Queens and workers are produced by the union of a queen with a drone. But drones are produced parthenogetically—that is, a drone has no father. But since the temper of a stock of workers is inherited from their father, the drones in that hive, not having inherited from their sisters' father, are not to be depended on. Their temper is derived from their mother's father; and so our drones should be selected from hives whose queens' sisters were good-tempered. In other words, decide on your drones by judging of the temper of their *grandmother's* progeny.

Suppose you have 30 or 40 hives, how are you to remember from which one you bred the queen of another? There is only one way. You must take copious notes. Every hive must be numbered, and the date (or at least, the month) of birth of its queen entered, where known; and you should also state from what hive you bred her. Thus, suppose you bred a queen from hive No. 1 and formed a new stock in No. 7 with her at the head of it—she having been hatched from the cell about March 10, and found to be laying eggs about March 18—you will write up your notes somewhat on these lines:—

> "No. 7 Queen from No. 1 hatched 10th March, laying 18th March, 1907. Fertility good. Energy fair. Temper good."

You can add other notes as you see fit; and when you replace that queen by another, you will carefully enter that. Then, suppose you take one of No. 7's progeny and make her queen over No. 16, you proceed in the same way. Thu you have a complete record of all your observations in apiculture. And, unless

you make up your mind to do this, you can never hope to make a real success of apiculture.

REARING QUEENS.

Remove a queen from a hive, leaving plenty of unsealed brood, and in a few days you will find the workers have built cells something like an acorn in shape in various parts of the comb. These are queen-cells. But queens have a market value ranging anywhere from 50 cents to Rs. 1,500—the general average for Europeans being about Rs. 3·00, but the price very frequently going to Rs. 20 or Rs. 30. And since bees, in a natural way, will only raise about a dozen cells, enterprising queen-breeders have devised a method of improving on Nature.

First, they are careful to choose a very strong colony, because the best queens are reared in hives containing a very large number of bees. This stock they decide to use as the nursery. They then make a frame of exactly the same dimensions as the frames used in their hives, but without a top-bar. It has, however, a bar placed horizontally across it, whose upper edge is 2½ inches below the extreme top of the side-bars. This is nailed in position, and two lugs are fixed on to the side-bars so as to form supports on which the frame can hang. Then, within the side-bars are fixed two thin strips of wood 2 inches long, resting on the horizontal bar, so that they reach up to within half-an-inch of the tops of the side-bars. These strips thus form a support for another bar to be laid across from end to end of the frame, which will then take the place of the ordinary top-bar of the frame. *See Fig. I.*

A bar is now made, ⅞ inch wide and ½ inch thick, long enough to rest easily on the two supports; and this is pierced with about 12 or 14 holes of ¾ inch diameter. *See Fig. II.* This is called the cell-bar.

In *Fig. III*, I have tried to represent the cell-cups. These are small solid cylinders of wood of diameter sufficient to allow them to pass easily into the holes in the cell-bar, ⅝ inch long, but with a flange at one extremity large enough to prevent them from passing right through the holes. Thus they will hang in the holes and can be easily drawn out. At their other extremity a shallow hollow is scooped out, ⅜ inch deep and ½ inch across, forming a little cup. A dozen or so grafting-plugs are also required. These are exactly like cell-cups, only that no cup is hollowed out in their base. They are used to fill up any of the holes in the cell-bar that it is not wished to fill with cell-cups. It is useful to paint the upper end of the cell-cups white and the grafting-plugs black, so as to be able to see in a moment which are cups and which mere dummies. And the date of grafting can be pencilled on the white surface of the cups.

Lastly, a grafting-needle is required. But a fine quill, clean and pointed like a pen and the point turned back slightly to form a sort of scoop, will answer the purpose perfectly. And nursery-cages are necessary for extensive operations. *See Fig. IV.* I will refer to them later.

All the lower part (*i.e.*, below the horizontal bar) is to be filled with comb. It is best to fill it with foundation; but when dealing with *mee-messa* (at any rate, until we get foundation made of size suitable for these bees) it will be preferable to place a thin strip of starter-foundation along under the horizontal bar. A 2½-inch wide strip of wood must be placed over the horizontal bar to prevent the bees building comb there. Then, when the lower part is nicely filled with comb, we are ready for the main operation.

Take a frame of brood from the hive you have selected to rear your queen from, and, after paring down the walls of some of the cells, with the grafting-needle lift out a grub and place it in one of the cell-cups, which have been previously lined with wax. The grub should not be a big one; nor should you take an egg. But it should be just beginning to assume a curved shape. If possible—though it is not absolutely necessary, but it insures more perfect success—the cup should have been previously dressed with a little "royal jelly." The strip of wood is removed and the cell-bar placed across the frame, and the grafted cups inserted. Your nursery-hive is then deprived of its queen, and the frame placed in the very middle of the brood-nest.

Two days after grafting, lift out the cups one by one, replacing them temporarily with grafting-plugs, and examine whether the grub has been accepted. If it has, it will have become enormously fat from its special feeding; and any cups that have not "taken" can be re grafted. When the cups are sealed over, you can do as you please with them. Meanwhile, it is important to recollect one or two points in dealing with embryo queens. Cells should never be touched by the hand—a slight pressure might impair the future queen's laying powers—nor should they be exposed to direct sunlight or cold. Remember that, though the day be warm and sunny, a wind is always chilling.

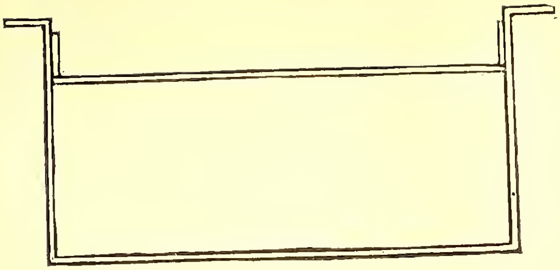


Fig. I.—Top bar of frame.—(Page 254)

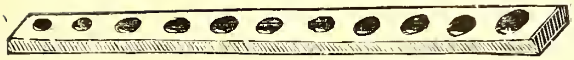
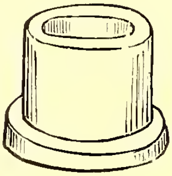
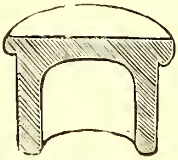


Fig. II.—Cell bar.—(Page 254.)



Cell Cups. (Page 254)



Actual.

Sectional.

Fig. III.

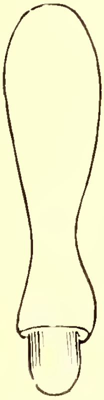
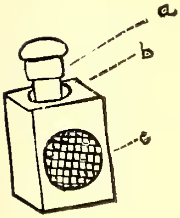


Fig. V. Diameter of point $\frac{3}{8}''$.—(Page 154.)

Fig. IV.—(Page 254.)



Queen-cell nursery cage, showing how capped cell is inserted through top hole $\frac{3}{4}''$ diameter.

a. Cell-cup.
b. Queen-cell.
c. Wire gauze window, 1″ diameter.

It is useful to have a $\frac{3}{8}''$ hole in base with a cap to fit it. Candy can be stored there.

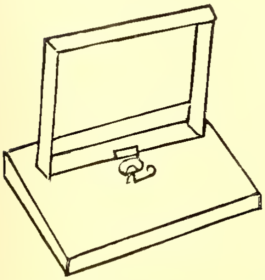
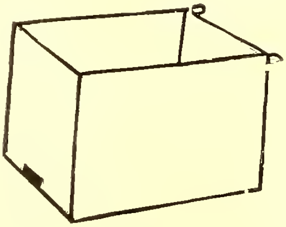


Fig. I.—Roof of mating-box. (Page 259.)



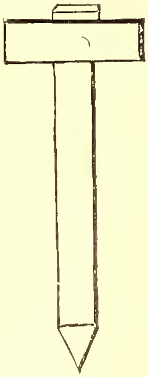


Fig. II.—Mating-box with stand.—(Page 259.)

If you are breeding a large number of queens, you will need small nuclei in which a few bees can tend the sealed cell until the queen is mated. But if you are only raising a few, you can, as soon as the cells are sealed, remove the cell-bar and stand nursery cages (previously supplied with "queen-candy") on the horizontal bar, and insert a sealed cup in each. Then you can deal with the hatching queens at your leisure.

I said above that the queen of the nursery hive was to be removed. But it is better to cage her, leaving her in the hive. Then, when you have all your queen-cells caged, you can release the old queen for a fortnight or so before caging her again for another operation. Large breeders insert two queen-rearing frames at a time; and some of them utilize the horizontal bar as a second cell-bar. Thus they can raise about sixty queens from a hive every six weeks or so.

In order to get your young queens mated, you must have a few nucleus-hives ready. As these require a certain number of bees that would otherwise be employed storing honey, many breeders now utilize quite diminutive hives for the purpose, with only a cupful of bees in each. But until you gain experience, I would recommend the employment of an ordinary hive, contracted by dummy-boards to hold just three frames—the two outer ones containing honey and the centre frame brood. Six hours after forming this nucleus (having, of course, been careful that you have not placed an old queen in it) you can run one of your virgin queens in, and she will almost certainly be accepted. But, if she is of great value, it will be better to introduce her by means of a cage. A few days later she will be laying, when she can be taken out and sold or used to replace an old queen in one of your other hives; and a second virgin can be supplied to the nucleus. If you go on using a nucleus for a long time, you will have, now and then, to introduce a few more bees to it, in order to keep up its strength. Or you can unite the nucleus back to its parent hive and take fresh three combs of bees.

There are still two points that may require elucidation. I said you were to line the cell-cups with wax, and recommended dressing them with "royal jelly." For the first, fill the cup with melted beeswax, and, while it is still not quite hard, press down into the cup with a stick shaped as in *Fig. V.* The wax will then squelch up above the level of the walls of the cup and so form a beginning of the cell wall. The stick must be moistened with the tongue to prevent its adhering to the wax. And once a cup is formed, so long as it be kept clean, it can be used again and again for queen-cells. As regards royal jelly, this is the special food provided by bees to their embryo queens. One newly-sealed queen-cell will yield enough jelly to dress twenty cups or more; and once a queen has been raised in a cup, the cup retains the scent of the jelly and so does not really require re-dressing. If you have not a queen-cell from which to obtain jelly to start you off, you can easily get your bees to make one. I will leave it to your reasoning powers to decide how this is to be done!

SELECTING DRONES.

You may take it as certain that, at the immediate close of the monsoon, no stocks of bees will contain drones unless under the direct control of man. As a period of wet weather prevents the bees from foraging, it is natural that they will not tolerate the presence of lazy and greedy drones, which only consume stores that might mean life or death to the colony. Thus drones, at such a season, are unnatural; and man is the only creature that can force Nature out of her usual groove. Therefore, if you see drones immediately after the monsoon, you may take it as practically certain that they are the result of man's interference. Now, no man is going to be such a fool as to breed up a lot of useless drones without some object; and his only object can be for breeding purposes—in which case you may say that he has selected those drones. Hence, though you may not know who it is among your neighbours that is breeding drones, you need not be alarmed at the idea of one of your virgin queens mating with such a stranger; for you may depend upon it that the drone has been selected for some special quality—probably gentleness. I must warn you, however, that a wild stock may easily have drones at that season, even without man's interference; but that will be because the stock is queenless—and, having regard to the season, the stock is almost certain to be hopelessly queenless, or at least so near to it that the bees are losing heart. So that such drones would not stand a hundred to one chance of mating with a virgin queen, if there were any competition from drones bred in a strong and hopeful hive. Thus, if you have been careful to rear drones, then you may be certain that your virgin queen has mated with one of your well-fed and well-cared-for drones to the exclusion of any mangy and ill-fed creature from a chance stock. Hence you will see that you *can* almost certainly insure your queens mating with a selected drone. And the probability is greatly enhanced if the hive containing

the virgin and that containing the drones are situated near one another.

But this is not enough. You want to be able to insure (or practically insure) selective mating at any time in the season; and this you can also manage with care. First, you must remember that, in the middle of the honey-flow, all your hives are likely to contain drones. This you do not want. You require to select the hive whose drones you decide to utilize and get rid of all other drones. This you can do by using a drone-trap, which can be bought cheap from any dealer.

But there are still the wild drones and those in your neighbours' hives to eliminate; and, just as before you got over this difficulty by selecting the time of year for your breeding-operations, so now you can select a time of day when it is unnatural for drones to be outside the hive. A drone is a lover of the warmth and only ventures out in the warm hours of the day. If, therefore, you can induce your virgins and selected drones to fly after 5 p.m., your queens are practically certain to mate with your selected drones. You can do this, provided the evening is warm, by pouring warm syrup into the hives. The bees at once become so excited over the sudden feast, that the temperature of the hive rises considerably, which induces the drones and young queen to imagine the outside temperature to be higher than it really is. As a last resort, if they will not take wing, you can lift out a frame or two and shake the drones outside—it is usually the drones that are the laggards.

I have more than once heard it said that *mee-messas* are so bad-tempered in comparison with European bees, and withal such inefficient honey-gatherers, that we can never make any marked improvement in them in one person's lifetime; therefore we ought only to keep European bees. Now, though I prefer European bees, I regard this as a most mischievous dogma. Depend upon it, the bee that is native here has an enormous advantage by heredity over all others. In England people are giving up keeping pure Italians, preferring a cross of English blood as tending to harden the race. And the same applies to the *mee-messa*. If you notice that one of your hives contains *mee-messa* of a larger size than the rest, then, by breeding (and even a little excessive in-breeding) from that hive, you will increase the size of your bees. It is believed that the dog has been under man's control for somewhere between 50,000 and 100,000 years—that is, about 15,000 to 30,000 generations. And during that time man has produced from common ancestors the Great Dane and the Blenheim Spaniel, the Greyhound and the Bulldog; and it is extremely unlikely that he has been following out scientific lines of selective breeding for more than five centuries. We are so situated in Ceylon, that it would be perfectly easy to breed eight generations of bees in a single year; and we by no means require such marked differences in our objective as we observe in dogs. In three years we can get through twenty-four generations of bees; and if you really think we should be unable to make an appreciable difference to our bees by then, I would recommend your studying the question a little. With our present knowledge, I should think twenty-four generations would be ample to breed the *mee-messa* up to the size of the European bee.

Then, again, why are *mee-messas* bad honey-gatherers and ill-tempered? I do not know how long ago people in Ceylon began to keep bees in chatties; but I imagine 3,000 years is a very moderate estimate. Well, during those 3,000 years—say 3,000 generations—which bees have been consistently destroyed for the sake of their honey? Naturally, those that had stored the most honey—and to a certain extent the more gentle bees. We prefer to get the greatest good at the least inconvenience! Therefore, any stock that was lazy over honey-gathering, any stock that was bad-tempered, any stock that was unprolific in bees was left severely alone to continue the species. All that were really good were destroyed. I feel inclined to parody Lord Clive: "By God! Mr. Beekeeper, at this moment I stand astonished at the goodness of the mee-messa!"

II.

In a former paper I gave a rough outline of how to increase the number of your colonies on what we may call "bumble-puppy" lines. This succeeds perfectly well; but it suffers from two disadvantages. First, the strong colony, from which the frames were taken, is materially weakened, and the newly-formed colony is likewise by no means strong. Thus both require plenteous feeding. Secondly, both stocks are so disheartened, the one by being deprived of much of its brood and the other by losing (if even for a short time) its queen, that it is often a matter of weeks before they either of them settle down contentedly to work. And so the parent hive gathers far less surplus honey than it would otherwise have done, and the new stock gathers none—in fact, barely enough to tide it over the Monsoon. And owing to the chilling of young brood in the operation, a fearful wastage of strength takes place in any case.

In view of this, up-to-date apiculturalists have devised a method of increase more nearly on the lines of natural swarming which never disheartens the bees.

SCIENTIFIC INCREASE.

When a hive throws out a swarm what does that swarm take with it? Three things. A queen, plenty of young bees and a great amount of honey—every bee being gorged. Our object, therefore, must be to secure these necessities for a new colony; and they will then settle down contentedly.

Now, it is a simple matter to induce bees to gorge with honey; smoke them and tap the sides of the hive. Again, if you shake a frame of bees, the young bees will fall off more than the old. Therefore you have the outline of the operation clear.

Cover the entrance-hole of a hive with wire gauze or perforated zinc. Place four or five frames in it, one of which, at least, containing honey (or you can fill an empty comb with syrup) but *no brood*. The other frames can be filled with empty comb or foundation. Shove these frames up to one side of the hive and move a dummy-board up against them. This dummy-board should have a half-inch space between its base and the floor of the hive—or even an inch. Lightly tack a piece of stuff over the frames and dummy-board, leaving a flap sufficient on the side of the dummy-board to cover the rest of the hive. Your new hive is now ready to receive bees.

From a very strong colony take out, one by one, four or five frames and, lowering each in turn half into the empty part of the new hive, give a quick jerk or two downwards. This will dislodge all the young bees and most of the old ones. Return the shaken frames back to the parent hive. The bees left in it will be sufficient to hatch the brood from the shaken frames.

When the bees are shaken off the frames, they will fall to the floor-board and at once run under the dummy-board and form a cluster in the middle of the new hive. But you must be very careful not to shake the old queen in with them. Cover up the new hive and carry it into a cool, dark place, where it must remain six hours. By that time all the bees have discovered that they are hopelessly queenless, and will accept with joy any queen offered them. Moreover they are so madly intent on trying to get out, that they have no time to attend to any other unfortunate that happens to enter their prison. If you do not mind cutting your hive, you can bore an inch hole at one end and stop it with a cork. But, of course, if your hive is double-walled, you must have two holes (one in each wall) opposite one another and connected by a metal tube. The queen can then be grasped between the forefinger and thumb—she will not sting—by the thorax, very gently, and headed into the hole when the cork is drawn. The hive should now, if possible, be at once taken to a spot at least a mile away, and the entrance opened. There the bees can remain a fortnight before being brought back. But, if you cannot take them so far, then keep them imprisoned three days—but in this case a lot of bees will die of fretting.

If you were careful to make the bees gorge well before shaking, you now have what is practically a natural swarm which will settle down contentedly as such. And you can take another shake of bees from the parent hive in about a fortnight or three weeks. It does not really matter whether the queen you run into the new hive is a virgin or not. Preferably not; but if she is, when she has been accepted, you can introduce a frame of brood (ever so little) in order to keep the bees from following her out on her wedding-flight—or the same result can usually be achieved by means of copious feeding.

If the weather is wet or there is little nutural feed after making an artificial swarm, you had better feed slowly so as to induce the new queen to lay regularly and well. In a month your new stock ought to be growing very strong.

Bees may be taken from several hives, provided a frame be shaken from each hive without allowing too long a time to elapse between the shaking of each frame. But you must always be very careful not to get the queen in haphazard shaking. Again, if a populous hive throws out a very large nutural swarm, this can be divided, if you like, into two or three "shakes," and each will rapidly build up if given a fertile queen.

It may also be useful to remember that, before running a queen into a "shake," you can utilize that "shake" to start queen-cells in your cell-cups. But you must, of course, be careful to remove all the cups prior to running in a queen. If the cups are left with the "shake" for a day, they will be so far advanced as to be readily acceptable to a nursery-hive in the usual way.

There is another point that may, perhaps, puzzle a beginner—how to get empty, fully-made combs. Take the outside comb from a strong hive. This will almost certainly contain only honey. Place it outside in the apiary at some distance from the hives; and in a short while the bees will have effectually licked all the honey out.

TO FIND A QUEEN.

As a general rule, the queen will be found on one of the central frames of a hive. But this does not invariably apply; and as many operations in apiculture imperatively demand the removal (or, at least, the location) of a queen, I will give a few hints to enable the tyro to find her easily. I surmise, of course, that he is acquainted with the appearance of a queen when he sets eyes on her. Once seen, no one can ever mistake a queen for a worker or drone.

Italian queens are never hard to find, as they and their attendants stand perfectly still when the frames are lifted out. This also, I believe, applies to Caucasians. But in the case of the English Black and the Mee-messa—and in a lesser degree the Cyprian—the queen tries to bury herself under her attendants when the frame is lifted. If, therefore, you find it hard to discover a queen's whereabouts, proceed as follows:—

Place an empty hive beside the one you intend overhauling, and, beginning with the outside frame on one side of the full hive, take out the frames one by one, and, after examining them carefully, place them in the empty hive, being careful to maintain them in their original positions in regard to one another. In this way the queen has no chance of crawling from an unexamined frame on to one that you have already inspected; and as you are not hurried, you are sure to find her—at any rate, on the second inspection. If you wish to get rid of her, pinch her head or thorax; and if you desire to cage her, lift her gently by the thorax (on no account touch her abdomen) and head her into the cage. If to be sent by post, you must also put a few young bees in with her. These are much more downy than the old bees.

It is possible that you may require to find the queen of a vicious colony. This is never a very agreeable business; so I will try to assist you here with advice. Remember, worker bees remain in the hive for at least a fortnight after emerging from the cells; and these young bees are never vicious. Your object, therefore, must be to rid the hive temporarily of the old bees. Towards the middle of a fine day remove the vicious colony to a fresh locality, and in its place stand an empty hive previously fitted with one comb of open brood taken from a quiet lot, together with some frames of comb or foundation. By the middle of the next afternoon all the old bees will have found their way to this new hive, because it occupies their old stand; and you can, if you wish, give them a sealed queen-cell or a caged queen. You can now examine your quondam vicious hive with impunity. If you would prefer to unite the two parts of the vicious hive again, instead of making a fresh stock from one half, you can bring back your original hive to the old stand, setting it above the new one with a sheet of wire gauze to separate them. This can then be withdrawn in a couple of days—as soon as the upper hive has the scent of the lower.

This principle of working with a wire gauze between an upper and a lower hive is often employed for the purpose of building up a weak stock. The weak colony is super-imposed on a strong one; and the warmth rising from below will enable the upper stock to build up far more rapidly.

NUCLEI.

I now propose to deal shortly with the question of small nuclei or mating-boxes. If you decide to rear queens extensively for the local market—and I warn you, there will probably be money in it for some years to come!—since the mating of each queen requires her to be placed in a separate hive with a separate lot of attendants, it is mere waste of material to give each virgin more than two or three cupfuls of attendants at a time. But such a small number of bees will find it hard to cover one large frame properly. Therefore, the custom has arisen of allowing each nucleus to have two or three small combs, three of which, when placed end on, exactly fill a standard frame. And so, when you have finished with your nuclei, you can build them together into standard frames and unite them into a few strong stocks. Two of these small frames are really quite sufficient in each box, which, to accommodate them, must, therefore, be 3¾ inches wide inside measurement, and 9¼ inches deep. Their internal length will depend on the thickness of the wood of which these frames are made; for you must be careful to allow ⅜ inch bee-space between each end of the frame and the end walls of the hive. You require, of course, a small entrance-hole; but the floor can be nailed on to the walls of the hive.

The roof is more complicated, as it is so constructed as to hold the frames in place, so that, when lifted off, the frames come with it. *Fig. I.* will give you an idea of how to arrange for this; but there are several methods employed; and probably your own ingenuity will be able to improve on it. Over all should come a second roof of tarred paper whose edges hang well down over the sides of the tiny hive.

I am myself inclined to prefer having a round hole in the under roof ¾ inch in diameter, and to cut the top-bars of the frames to correspond. Then either a sealed cell or a virgin in a round cage can be slipped in without disturbing the bees. This hole can be plugged, when not in use, by means of a grafting-plug—or, better still, a cork.

And now to stock your little hives with workers. Let one comb in each contain honey or syrup, and the other be empty or consist of foundation. By cutting up a full comb, you can easily attach it to the little frames by means of wax. Take the frame containing the queen from a colony and place it in an empty hive, letting that hive occupy the old hive's original position. Then smoke and drum the old hive, so as to make the bees gorge. Then shake them off their combs into the hive and hang the combs in the new hive with the queen. If the bees are properly filled with honey, they will not sting nor fly out of their hive when shaken, but, when the final comb is shaken, will cluster on the side. Move your mating-boxes up close to this hive, and, lifting off the lids one by one with one hand, with the other scoop up two or three cupfuls of bees from the cluster and dump them into the small boxes, closing down the lids at once. If the entrance-hole has been previously closed, they will, in six hours, be ready to accept a virgin when run in among them.

It is as well to remove all your nuclei to a place at least a mile away, ranging them round a hive containing the drones you wish to mate with your queens. In five days you should, if the weather has been fine, find that the young queen has laid eggs, when she can be at once disposed of, and a second introduced. As the boxes now contain open brood, a virgin cannot be run in as before; but a sealed cell can be given, or a virgin can be introduced in a cage.

You will note in *Fig. I.* that the frames of the nuclei are so attached to the roof, that they can easily be moved slightly to one side to facilitate examination for eggs or queen.

Sometimes you will see a cluster of bees hanging on the outside of a populous hive and doing no work. It is a sign that the hive is very full and about to swarm. But there is no reason why you should leave these bees in idleness if you have other work for them. Spray them with syrup, and then scoop them into a mating-box. Or again, you can take a scoop from a natural swarm without materially weakening it. There are various ways of filling up your boxes; and probably you will be able to devise other methods of obtaining a few bees yourself.

Unless you are pressed for room, leave the newly-mated queen in her mating-box for a week, as the eggs she then lays will be sufficient to keep up the nucleus to proper strength. Otherwise you may have to add bees to your nuclei from time to time by hand.

Fig. II. will give you a rough idea of the appearance of a mating-box; and I have only to call to your mind that smoke, or thin warm syrup will always quiet bees sufficiently to permit handling; and that you must always be extremely careful in touching a queen, so as not to impair her laying capacities.

III.

A few words may not be out of place here with regard to the financial side of bee-keeping. And let me say at once that I would not have the beginner run away with the idea that he is going to make a small fortune out of this industry. To do so requires years of experience; and even then a man should possess several hundreds of hives and combine the production and sale of honey with a factory for the supply of apiarists' requisities. At the same time, however, there is no doubt that a small apiary, properly managed, ought to provide its owner with a delicacy for his table, and, at least in part, pay the rent of his house. It may even do this last altogether—it depends much on the man,—and, in addition, put a few rupees into his pocket. Let us consider, therefore, the expenses of a year's working on five hives, together with the capital outlay.

I will suppose that the apiarist decides to go in for the native *mee-messa.* A hive such as I have described will cost him about Rs. 10; frames and dummy-boards Rs. 2·50; bees—supposing that he joins up three stocks from chatties into one—at the outside Rs. 6. Total per hive Rs. 18·50. Total for the five hives Rs. 92·50.

We will suppose that he has laid out Rs. 20 on small accessories from England, for which sum he will have got a great deal—enough foundation, for instance, to last him many years. His capital, therefore, is Rs. 112·50 at the outside.

His expenses for the year consist of time, which cannot justly be reckoned, since he can afford this (say an hour a week) out of his spare moments; rent of land occuped by the hives, which, seeing that hives are best kept on barren pieces of land, may be generously estimated at Re. 1; and sugar for feeding the bees, which can be estimated at Rs. 2 per hive. His expenses, therefore, are Rs. 11.

From each hive he ought to get 40 lbs. of surplus comb-honey. This amount is secured at home in bad seasons. So let us be well on the safe side and place his harvest at half that amount. Thus he has 100 lbs. of honey to dispose of, for which he ought certainly to get Re 1 per lb. But if, by mismanagement, he only gets the half of this, his gross returns are Rs. 50; and his nett profit is, therefore, Rs. 39—that is, nearly 35%.

But in addition to this he has also secured at least one swarm from each hive, each of which he ought easily to be able to sell for Rs. 6 to Rs. 10. In fact, his nett profits should show somewhere in the neighbourhood of 60%.

Now, let us look at it from another point of view. The bees in three chatties are worth about Rs. 6. But when they are established on frames in a proper hive, they are brought under man's complete control. What are they worth then? I take it, at least double. Bees in a chatty may die out—they may be robbed and killed by *bambaras* or starved to death in a severe Monsoon—and man can do little or nothing to save them. In a bar-frame hive, however, he can always save them. Therefore he runs no risk of losing his capital. The difference in value, therefore, is much the same as between Consols and a Venezuelan mine! The apiarist's assets, then, are considerably enhanced by a little work. If, instead of selling his swarms, he elects to add them to his apiary, he will open the second year's account with a capital of about Rs. 175, from which, reckoning his harvest as before, he reaps a nett profit of Rs. 78, in addition to ten swarms valued, at the lowest, at Rs. 60—which is not far short of 80%. If he choose to retain these ten swarms, his third year will open with a capital outlay of Rs. 300, from which his honey alone, on the lowest computation, brings him in over 50%. And it must be remembered that, since his experience will, during the past two years, have increased considerably, his harvest will undoubtedly be doubled and he will realize higher prices for his honey. With twenty hives, therefore, he should net a profit of about Rs. 300 to Rs. 400.

DISPOSING OF SURPLUS SWARMS.

At first the apiarist will, no doubt, find some trouble in disposing of surplus swarms. He should, therefore, whenever he receives an order for one, be careful to supply only gentle bees. This will encourage other (perhaps more timid) purchasers—especially if he lets it be known that his bees have put a few hundred rupees in his pocket. There is something peculiarly attractive to the ordinary mind in watching something else coining rupees for his benefit! One can fancy the old Latin writer winking as he inscribed those well-known words: "*Sic vos, non vobis, mellificatis apes.*"

When you receive an order for a swarm, shake it off the branch on which it has clustered into a box, and cover it at once with a strip of butter-muslin or mosquito-veiling doubled, and tie or tack the muslin securely round it. It can then be sent off by train without delay. It should, of course, be labelled to be carried with the muslin downwards. Probably, however, your customer will ask for a stock of bees already on frames. In this case you will charge him for the hive. One such as I have described is well worth Rs. 25; and you ought to charge at least Rs. 2 to Rs. 2·50 per frame of bees. It will be necessary, also, to secure the frames, lest they jolt about in transit. This can be done with a strip of wood screwed above them straight across. For a very long journey—say to India—a special hive should be made with windows in its sides covered with perforated zinc; and in any case a strip of this material will need to be tacked lightly over the entrance-hole. See that the bees have enough stores to feed on. And, of course, you must secure the floor to the body-box. For a long journey, also, the combs should be wired into the frames. This can be done by means of four or five perpendicular wires (No. 30 tinned) drawn taut, which are sunk into the foundation or starter by means of a Woiblet Spur-embedder, which costs about 1*s*. 6*d*. in England. This will prevent the combs from breaking down when the hive is shaken in transit.

EUROPEAN BEES.

At present we may place the value of European bees in Ceylon at about Rs. 12 to Rs. 15 per frame—or six frames at Rs. 60 to Rs. 75. As the number of stocks in the Island increases, the price will, of course, sink. But they should always be worth at least Rs. 30 for six frames. They are so easy to handle—as an American advertiser states, they will "come and eat out of your hand"!—that any one that can save up enough money to purchase a stock will inevitably prefer to have them.

It must, however, be remembered that the initial outlay in starting an apiary of European bees will be considerably larger than in the case of *mee-messa*. And though, as far as we can see at present, the European bee should yield a far larger harvest of honey, I would recommend the beginner to start with *mee-messa*.

If you chance to purchase a stock of bees on frames to start your apiray, you will probably find that the combs (especially if they are European bees) are dark brown in colour. Some novices are apt to look on such a colour as a suspicious sign, though without reason. No comb is pure white unless it has never contained brood—the cocoons from which the young bees emerge giving this shade of brown. Indeed, the older and browner the comb, the better for trevelling, as such combs are extremely unlikely to break. In selling bees, therefore, you should inform your customers of this. Again, it often happens that, at the end of a winter (or Monsoon) many of the cells contain a mildewed mass. This is nothing more than pollen that the bees have not used. Such combs should, if possible, be given to a strong colony to clean up. Or, if you prefer it, you can cut out the mildewed parts with a sharp knife and return the damaged frame to the hive to be repaired. The pieces of comb can then be rendered down. There is, by the bye, a very good maxim to remember: never waste the smallest particle of wax. It is always valuable, and is often very useful to have on hand.

HANDLING BROOD.

Many treatises on apiculture recommend the spreading of brood-combs with a view to forcing the queen to lay quicker. This has been proved to be safe in the low-country; but in the colder climate of the high lands it is a thing to beware of. The idea is to shift the frames to either side from the middle, and to insert, in the very heart of the brood-nest, a frame of foundation or fully drawn-out comb. The danger is that, during the cold nights of the higher elevations, the bees will be inclined to cluster towards the centre, leaving the outermost frames deserted. Thus the brood in the outer frames will get chilled and die. It will be noticed that bees (and especially *mee-messa*) will be inclined to build more towards the front of the hive. If, therefore, the frames run at right angles to the entrance, you can, if you wish to spread brood, start by reversing all the frames from front to rear. You should be careful, however, to replace them in the same relative positions to one another. Thus, the frame taken from the extreme right will be put back on the extreme left, and *vice versa*. In this way you will induce your bees to fill up all the frame. You will find that, once a comb has contained brood, the bees prefer to utilize it for that purpose again.

BRACE-COMBS.

The native bee (and in a far lesser degree the European) will be found to build small pieces of comb across from one main comb to the next. This is done for the sake of strength. You must be careful, therefore, in such cases, before you lift out a frame, to pass a sharp knife gently through these brace-combs. They are invariably near the top of the frame, so that they are easily got at; and as the bees only store honey in them, you will not be destroying any brood. On the coutrary, the fact of laying open such a store of sweets will cause the bees to be very easy to handle, as they will be busy licking it up. Of European bees, I fancy the English Black is the worst offender along these lines, while the Cyprian is probably the best.

PROPOLIS.

This is a sort of glue that bees gather from various places. They use it to block up small holes in their home, cover over any dead thing that is too large to carry out, and to fix combs firmly to the sides of hives. So far as my experience goes, propolis gathered in Ceylon is far less hard than that gathered at home. Sometimes in England the quilts are so firmly glued down on top of the frames and the frames themselves so effectually stuck to the runners on which their lugs rest, that it requires a considerable wrench to get them loose. This, of course, irritates the bees. If you use the true Hoffman frames, you will find that European bees will invariably glue their shoulders together, so that you will need to ease them gently but firmly apart. By using W. B. C. metal-ends, however, you will experience far less trouble. The English bee is the worst propolizer; while the *mee-messa* is undoubtedly the best—hardly employing the substance at all. That is another point in favour of the native bee.

CLEANING.

It is as well always to have at least one spare hive. Once a year go round all your hives, transferring the frames to an empty hive, and then well scrubbing (and, if necessary, re-painting) the old hives, letting their interiors be thoroughly saturated with sunlight. There

is nothing like direct sunlight for killing out germs and obnoxious insects. Your first hive can be transferred to the empty one; and when No. 1. is thoroughly clean, No. 2 can be transferred to it, and so on.

In their natural state, bees have not this advantage, and many stocks die out. But man can improve on nature and insure prosperity to his little labourers.

(To be concluded.)

Correspondence.

ALGAROBA BEAN.

DEAR SIR,—On page 233 you answered a question on the Algaroba tree, or Algaroba bean, which has been introduced into Hawaii some time ago. You are quite right, this middle-sized tree is a species of Prosopis, namely—*Prosopis saliflora*. It thrives splendidly on dry situations in Hawaii with an average yearly rainfall of thirty to forty inches; but not so in Guam, with an average of hundred inches per year. The flowers are much favoured by bees, and the sweet bean-like pods are much relished upon by all domestic animals. They are somewhat similar to those of the Carob-tree (*Ceratonia siliqua*), and are like them full of a juicy pulp containing sugar, gum and some astringent substance. But the pods of Algaroba are smaller than those of the Carob, and in size like small French beans.

K. L. V. COSTENOBLE,
Supdt., Agri. Experi. Station,
Island of Guam.

December 18, 1907.

GOWRI SANNA.

SIR,—I take leave to give you the result of my experiments with the Indian wet paddy, Gowri Sanna, a small supply of which the Superintendent of School Gardens kindly sent me in August last. Distributed amongst six of us, we tried it in different soils and in the ordinary way. We sowed it for Maha season, at end of August, bone manure being used in what appeared to be poor soil. Notwithstanding unseasonable weather and floods, the plants thrived well enough, and, just like the indigenous, with the little difference of the foliage which was brighter.

Strange to say, with one exception, the ears, which began to appear in the fourth month, lacked sap or the "milk" as we call it. No flies attacked it; nor could it be said to be immune, for what of the plot so successfully grown under same conditions? In his memo. Mr. Drieberg says that this paddy is sown in June. The cause, therefore, is to be looked for in this direction.

Where it yielded a return was a *deniya*, protected on three sides by gardens, and although the land was completely under water for five days, the plants, which were about one month old, emerged unscathed.

Another danger had to be encountered in an unexpected direction. Birds had to be kept off. This plot yielded six measures, quantity sown being ¼ measure, or 24 fold. It is hardly sufficient to meet the demand, so many people are asking for it.

Here is proof, if proof were necessary, of practical methods rather than lectures and pamphlets, etc., which no doubt are good in their own way. I know seed paddy procured from a distance yields far better crops; and, as if by instinct, people take to "new" kinds. See the acclimatization of Samba, Sulai, Murungwi, Rata-wi, etc.

The country paddy sown at same time is about one month behind. So that Gowri Sanna must go with our Māspassa.

GEO. WEERAKOON,
Mudaliyar.

Talangama, 11th Feby., 1908.

RUBBER PESTS.

SIR,—The one thing which, with all respect to Mr. Herbert Wright, I think is wanting in his standard work on rubber is a chapter on "Pests," treating fully all such—fungoid, animal, or insect. The subject is, however, such an important one that a separate book might almost be written. At the present moment I know of no book or pamphlet on the subject; and those (like myself) who have not been so fortunate as to take in the "*T. A.*" since the rubber "craze" started, have either to weary you with "damned reiteration" by asking questions on matters replied to before, or do without information and worry through by ourselves. Unfortunately, in Burma, the "*T.A.*" is not a Gov ment publication, so I cannot follow the advice once given to a seeker after knowledge—to go and look through the files of the "*T.A.*" in the nearest Kachcheri. I am sure that planters from Malaya, India and Burmah, and of course Ceylon, would give all help and information in their power to any one writing

a book on the above most important subject.

J. G. F. MARSHALL.

Tavoy, Burmah, 18th February, 1908.

MOLE RAT AND GREEN WOOD-BORER (*CERATINA BEE.*)

SIR,—I send the clean skull and the skin of the "mole rat" which does so much destruction in Burma, for favour of identification. The skin is not a good one, as I fear I am a bad taxidermist, but I hope it will serve its purpose.

I also send per this mail, in a hollow bamboo, specimens of the boring bee and its depredations. That boring is done in green wood will, I hope, be conclusively proved by the stem sent. This boring is quite an insignificant one compared to some I have come across. These specimens should have accompanied a letter of mine despatched two mails ago, but were overlooked.

J. G. F. MARSHALL.

Tavoy, 10th January, 1908.

II.

SIR,—With reference to three letters to you advising despatch of a mole rat, skin and skull, and specimens of the Ceratina bee and its works, I have now to say that I have had both parcels dumped back to me by the Post Office, marked "unclaimed." The village postman, who brought the letters, could give no further explanation. The note "unclaimed" is an obvious lie, as neither parcel bears any Ceylon post mark, and they have apparently never left Burma. I am now making enquiries, and hope in due course that the specimens will reach you. This is simply sickening. We pioneers can get no help or assistance in naming specimens in Burma, and when we try to get you to kindly do so, we are treated in this way. I suppose I have transgressed some rule; but, if so, why the Post Office here (Tavoy) could not have told me at once and saved much delay and worry I do not know. In the meantime I can only apologise for the delay in sending the specimens.

J. G. F. MARSHALL.

Tavoy, 20th February, 1908.

RUBBER: AXILLARY BUDS.

SIR,—My Para trees of 1905 and 1906 planting are now wintering pretty generally. The trees that have quite ost their leaves (and which have not yet been thumbnail pruned, not having reached 12 feet high) are worrying me considerably by sending out a copious supply of buds from the axils of nearly every leaf, or rather from where the leaves were before falling. The leading bud at the same time looks vigorous and also starts growing. I am nipping off all these axillary buds, as they appear, of course. They have been so many that I have been forced to put men out to do it. Can you explain the circumstance; and have other planters had a like experience? Two very heavy showers which fell on the 1st and 2nd instant may account for the sudden growth, but why not the leader only, as usual with Para, unless pruned or killed back in my way.

J. G. F. MARSHALL.

Tavoy, 9th January, 1908.

P. S.—I also enclose a piece of stem of a half-year old rubber plant which is rather curious. I have come across some 30 or 40 such during the last two years. The plants were "rung" in some way about 6" to a foot or so above the ground, and proceeded to throw out roots from the upper portion as in the specimen sent. This looks as if propagation from cuttings or layers *should* be easy, but it is not according to your correspondents. I am making an experiment in cuttings, the result of which will be reported on in a month or two. In the specimen now sent, you will see that the "rung" portion of stem has quite recovered itself with bark, and the plant was flourishing, but had also sent up a sucker from below the injury.—J. G. F. M.

NOTES AND QUERIES.

BY C. DRIEBERG.

ENQUIRER ABOUT KOLA-NUT CULTIVATION.—I regret that your letter was mislaid, and hence my inability to communicate directly with you. The cultivation of Kola is very similar to that of Cacao, and you will be able to see Kola growing a few miles out of Matale on the North Road. The preparation of the nuts has already been described in these pages. It should be mentioned that the market for Kola is not particularly good.

JUTE.—Two correspondents enquire about jute seed—one from the North and one from the South. The enquiry is for true jute (*Corchorus*)—not to be confused with "Hana" (*Crotalaria juncea*) sometimes erroneously spoken of as jute. The idea of planting this fibre locally has no doubt arisen from the reference lately made to the planting of jute in place of rice in Bengal. In the first place this

substitution of jute for rice is probably now being discovered to have been a mistake. In the next place, as Dr. Willis says, jute does not grow satisfactorily in the equatorial regions or below Orissa. Local experiments in jute growing, made through the School of Agriculture many years ago, at the instance of Mr. (afterwards Sir) Alex. Swettenham, did not give satisfactory results.

LACE BARK.—The nearest approach to the lace bark of the West Indies is the bark of Nàva (*Sterculia Balanghas*).

M. (Moratuwa.)—Rambuk (*Sachcharum spontaneum*), so common in Ceylon, is much used for paper making. Another useful paper fibre is got from *Ischœmum angustifolium*, which is found to grow well in the Government Stock Garden under far from favourable conditions. It is certainly to be wondered that no paper mill has been established here.

M. P.—I am sending you the seeds you want. Sour Sops are very common about Colombo suburbs—particularly in the Cotta direction, where the soil is decomposed cabook (*laterite*) which the tree seems to affect; and yet the fruit is seldom seen in the town markets. I have just secured a few seeds for trial of what is said to be a hybrid between the custard apple and cherimoya. The Bullock's heart is not a favourite, though there is no good reason for despising the fruit.

H. G. M.—Yes, blue stone and blue vitriol are one and the same thing, viz., sulphate of copper. Green vitriol is sulphate of iron, and white vitriol is sulphate of zinc. Vitriol is another name for sulphuric acid.

BEE.—You should get your hives as strong as possible, so that you may take advantage of the "honey flow" (as it is called) which may be expected in April, when there is a rush of blossom including those of honey plants. Mr. Shanks lays great store by the Padouk (*Pterocarpus indica*), and all bee-keepers should be ready to take advantage of its flowering periods. Those who wish to make use of an honey extractor should apply to the Superintendent of School Gardens at the Government Stock Garden.

F. V.—Next month I shall be able to give you freshly imported cow pea seed; but, if you are particularly anxious to have seeds, I can send you a packet of some that have been raised locally.

BOARD OF AGRICULTURE.

MINUTES OF THE 39TH MEETING.

The 39th meeting of the Board of Agriculture was held at the Council Chamber at 12 noon on Monday, the 9th March, 1908.

His Excellency the Governor presided.

Present:—The Hon'ble the Colonial Secretary, the Controller of Revenue, Colonial Treasurer, the Government Agent W.P., John Ferguson, C.M.G., F. C. Loos, W. M. Abdul Rahiman, and A. Kanagasabai; Drs. Willis and H. M. Fernondo, Messrs. A. N. Galbraith, R. W. Smith (Acting Director of Irrigation), E. T. Hoole, W. A. de Silva, F. L. Daniel, and the Secretary.

There were also present as Visitors:—Messrs. Tudhope, H. P. Rudd, Gerard Joseph, Alex. Perera, J. Mathias de Mel, and two others.

BUSINESS.

(1.) Minutes of the previous meeting, held on the 3rd February, were read and confirmed.

(2.) Progress Report No. 38 was adopted.

(3.) The annual report on Castration work carried on by the Government Veterinary Department was laid on the table. Mr. W. A. de Silva criticised the method of castration adopted, and suggested what he claimed to be a better method in vogue in India. Dr. Fernando, Mr. Hoole and Mr. Ferguson also spoke. H.E. the President thought the matter might be left over till the return of Mr. Sturgess to the Island.

(4.) The Organising Vice-President submitted a statement showing the apportionment of votes under the Government Grant for 1908, and moved its adoption. The Hon'ble the Colonial Secretary, in seconding the motion, which was carried, deprecated the retention of large accumulated balances to the credit of the Society.

(5.) A statement of expenditure incurred during February was tabled.

(6.) The Hon'ble Mr. Ferguson read a paper entitled "The Possibilities before the Ceylon Agricultural Society: its Board and Branch Associations." The Hon'ble the Colonial Secretary moved a vote of thanks to Mr. Ferguson for his valuable and suggestive paper. His Excellency, in thanking Mr. Ferguson, outlined a scheme for more effective work, particularly among the cultivating classes.

The Organising Vice-President moved the re-constitution of the Board as

follows, which was duly seconded and adopted :—

Patron :

Sir Henry Arthur Blake, G.C.M.G., F.R.C.I.

President :

His Excellency the Governor.

Vice-Presidents :

The Hon. the Colonial Secretary
The Hon'ble the Colonial Treasurer
The Hon'ble Mr. John Ferguson, C.M.G.
The Hon'ble Mr. S. C. Obeyesekere
Sir William Twynam, K.C.M.G.
Mr. H. T. S. Ward
,, W. D. Gibbon
,, C. P. Hayley
,, P. Arunachalam, C.C.S.
,, F. H. Layard
,, Jas. VanLangenberg

Organising Vice-President :

Dr. J. C. Willis

Members of the Board.

Ex-Officio.

Members of the Executive and Legislative Councils (15)
The Government Agents of Provinces (7)
The Assistant Director, R.B. Gardens
The Government Entomologist
The Government Mycologist
The Government Agricultural Chemist
The Curators, R. B. G., Peradeniya and Hakgala
The Conservator of Forests
The Director of Public Instruction
The Director of the Colombo Museum
The Director of Irrigation
The Government Veterinary Surgeon
The Superintendent of School Gardens
The Controller, Experiment Stations, Peradeniya and Maha-illuppalama.

Nominated Members :

Western Province.

Sir Solomon Dias Bandaranaike, Kt., C.M.G. Maha Mudaliyar
The Hon. Mr. L. W. Booth, C.C.S.
Mr. E. B. Denham, C.C.S.
,, A. N. Galbraith, C.C.S.
,, H. Inglis
,, Solomon Seneviratne, Attapattu Mudaliyar, J.P.
Dr. H. M. Fernando, M.D.
Mr. Tudor Rajapakse, Gate Mudaliyar
,, W. A. de Silva
,, F. L. Daniel
,, James Peiris
,, J. D. Vanderstraaten
,, L. W. A. de Soysa, M.R.A.C.

Central Province.

Mr. W. Chas. Whitham
,, W. Dunuwille, Disava
,, R. E. Paranagama, R.M.
,, D. J. Jayatilleke
,, Daniel Joseph
,, C. Taldena, R.M.

Nothern Province.

Mr. V. Casipillai
,, C. M. Sinnayah Mappana, Mudaliyar
,, V. Vraspillai, Adigar and J.P.
,, K. U. Tampaiya, District Mudaliyar

Southern Province.

Mr. C. G. Simmonds
,, E. R. Gooneratna, J.P. and Gate Mudaliyar
,, D. A. Gooneratne, Gate Mudaliyar
,, B. T. Doole, Gate Mudaliyar
,, C. E. de Vos, Crown Advocate
Dr. E. Ludovici

Eastern Province.

Major P. B. Molesworth (Trincomalie)
Mr. Varitambi Kurunathapillai
,, C. A. Lienard
,, J. W. Kanagasabai, Vanniah, Manmunai N.
,, G. H. Kanagasabai, Vanniah, Panawa

North-Western Province.

Mr. E. Scott
,, S. N. W. Hulugalle, Adigar
,, J. Clovis de Silva
,, G. W. Dodanwela, Retired R.M.
,, A. W. Beven
,, Jacob de Mel
,, L. B. Bogahalande, R.M.

North-Central Province.

Mr. S. Sampander
,, C. A. Valoopillay
,, G. W. Jayawardana, Mudaliyar and J.P.

Province of Uva.

Mr. A. T. Rettie
,, James Duncan
,, H. O. Hoseason, J.P.
,, H. Dambawinne, Retired R.M.

Province of Sabaragamuwa.

Mr. P. D. G. Clark (Balangoda)
,, E. A. Elapatha, R.M. (Ratnapura)
,, J. H. Meedeniya, R.M.
,, M. Stevenson (Kegalle)

Secretary :

Mr. C. Drieberg, B.A., F.H.A.S.

CEYLON AGRICULTURAL SOCIETY: PROGRESS REPORT, NO. 38.

Membership.—The following members joined since last meeting (February 3) :—G. L. Cox, C. D. Hunt, the Right Rev. Dr. J. Van Reeth, S.J., R. C. Grant, R T. Sidgwick, H. O. Barnard, E. W. Jayawardene, W. Chas. Whitham, J. Conroy, Stephen de Silva, Don Philip A. Wijewardene, Muhandiram, F. H. Layard.

Branch Societies.—The Co-operative Credit Bank started by the Dumbara Branch continues to operate, and so far with satisfactory results. According to a statement brought up to the end of 1907, the bank started with a subscribed capital of Rs. 760. The gross incom

amounted to Rs. 83·85; after paying off interest to depositors (Rs. 26·80) and meeting incidental expenses (Rs. 20·49) a nett balance of Rs. 36·56 was carried forward.

This Branch has been giving attention to cotton, tobacco, and the transplanting and manuring of paddy.

The Wellaboda Pattu (Galle) Branch.—The Agricultural Show and Fair inaugurated by this Branch took place at Hikkaduwa Gansabhawa premises on February 22, and was formally opened by the Government Agent, Southern Province. The Secretary of this Society was present with Agricultural Instructor Wickremaratne, and helped in judging the exhibits, which were of decidedly good quality. The Branch Societies awarded six certificates for the best exhibits, and the Secretary of the Parent Society has recommended a special award for the best collection of vegetables, shown by R. D. S. Wimalasuriya. The Branch Society also offered three prizes of Rs. 30, Rs. 20, and Rs. 10 for the best gardens in the pattu. There were 33 entries, and Mr. L. A. D. Silva, Agricultural Instructor, did the judging. The result was as follows :—

(1) N. A. S. Jayasuriya's garden at Kapuhena.

(2) R. D. S. Wimalasuriya's garden at Kosgahawella.

(3) G. B. Wickremaratne's garden at Galduwa.

Coconut Stem Disease.—Reports received indicate that the coconut stem disease is very widespread; but it is satisfactory to find that all large landowners have adopted the remedial measures recommended by the Government Mycologist. The appointment of inspectors to enforce the treatment in small native holdings will probably be made by the beginning of next month. In the meantime the disease has been "declared" under the Plant Pests Ordinance, and the necessary Local Boards for enforcing the Ordinance have also been appointed.

The Director of the Royal Botanic Gardens, the Government Mycologist, and the Secretary, Ceylon Agricultural Society, paid several visits to the centres where the disease was reported to be specially bad. Demonstrations in the method of treatment—cutting, burning, and tarring—have also been given in various places, and the Society's Agricultural Instructors have helped in this work. The Society has distributed 3,000 Sinhalese leaflets through Government Agents and others. The Government Mycologist recommends as preventative treatment, especially for young trees, an application of a mixture of blue stone (6 lb.), freshly slaked lime (6 lb.), and 25 gallons of water. This should be applied to the trunk as high as practicable. In view of representations made from Tangalla, an Agricultural Instructor has been despatched to investigate and report, pending the appointment of Inspectors. The whole of the coconut area between Tangalla and Puttalam would thus appear to be affected. At the time of writing a letter from the Eastern Province mentions the occurrenee of the disease in the Batticaloa District.

Mr. H. P. Wickremesinghe, writing from Marawila, says: "I notice another form of disease in the shape of a leaf disease. Generally the non-bearing trees are very much affected with this. The only sign is that the matured leaves get spotted and the tender ones get dried up. In some cases the whole crown appears to be dried up."

The Government Mycologist reports as follows :—

"From the description this is the leaf disease caused by *Pestallozzia palmarum*. It occurs on palms througout the Island, but does very little damage, except to seedlings. The same fungus attacks tea and cinnamon, but is not considered dangerous. Manuring appears to have made the tea bush more resistant against its attack, and probably the same is true of coconuts."

Rinderpest in the North-Western Province.—At a meeting of the Wanni Hatpattu Branch held on December 22, the following resolution was adopted: "The Society feels it a pleasure to record its sense of relief and appreciation of the exertions of the Stock Inspector of the North-Western Province, which have contributed to the successful suppression of the outbreak of cattle murrain discussed at the last meeting."

Paddy Flies.—The ravages of the paddy bug were reported from two or three places. The Government Entomologist has kindly furnished the following information for the benefit of members: "The paddy bug, or rice sapper (*Leptocorisa acuta*), sucks the unripe grain and prevents maturing. No really satisfactory treatment for the rice sapper exists. The smoke of cowdung and various aromatic herbs can be recommended. Ropes covered with rags soaked in kerosine are sometimes drawn across the fields at the time the grain is setting. But neither of these methods appears to be very effectual. Perhaps the best direct treatment is the plan of walking through the fields and catching the insects on hand screens (winnows) smeared with jak juice. Much may be

done to check the pest by repeatedly burning off the grass on the bunds and in the fallow fields during the off season. The insect subsists at that time on the wild grasses, and lays its eggs on the grass stems."

Ground Nuts.—Writing in October last, Messrs. Finlay, Fleming & Co. of Rangoon state that they purchase groundnuts in the shell, the price ruling at that date being Rs. 150 to Rs. 155 per 100 baskets of 25 lb. each=2,500 lb. They mention Ruffisque, Mauritius, and Mosambique* as good varieties, and state that though the groundnut was introduced into Burma only four years before, the area under cultivation at date was 80,000 acres, so far confined to the dry zone, where the annual rainfall is 25 to 35 inches. It is considered a very profitable crop with a yield on an average of 1,300 lb.

Messrs. Finlay, Fleming & Co. express their willingness to purchase Ceylon nuts in ton lots from 2,240 lb. gross weight delivered Rangoon, price to include cost, freight, and insurance.

Messrs. A. S. Jamal Bros. & Co., also of Rangoon, writing in October last, state that they have been purchasing at gross Rs. 115 to Rs. 135 per 100 baskets of 25 lb. each=2,500 lb. They, too, express their willingness to purchase Ceylon nuts, c.i.f., on Rangoon terms.

Messrs. Ralli Bros. of Pondicherry, writing in August last, offer to supply Senegal groundnuts for planting in April. In forwarding a sample of these nuts raised in Pondicherry, they draw attention to the fact that "the kernel is in excellent condition."

Mr. Benson, Deputy Director of Agriculture in Madras, records that the Pondicherry Chamber of Commerce reported very favourably of the Senegal groundnut as a vigorous grower and heavy cropper. The oil from this variety is described as so good that the most fastidious epicure may use it in making salads. The seeds, according to the report referred to, are round and rosy in appearance, with an agreeable taste like fresh filberts. Regarding the Mauritius (or Mosambique) variety, it is stated that the seed contains a "resino gommeuse" substance, which, as it remains in suspension in the oil, delays the settling and gives a very pronounced taste to the oil.

According to Sir Thistleton Dyer, the following are the proportions of oil from the different varieties: Senegal 51, East Africa 49, American 42, Madras 43. Dr. Leather gives the percentage of oil in the Mauritius variety as varying from 44 to 49.

A limited supply of Senegal groundnuts is expected about April.

Agri-Horticultural Shows.—Trincomalee Society has decided on holding a Market Fair on March 7; Wellaboda pattu (Galle) a cattle Show and Fair (no date fixed); Nuwara Eliya Show takes place on April 21 and 22. It is probable that a Show will be held in Colombo under the auspices of the Colombo Agri-Horticultural Society, but no definite arrangements have yet been made. Writing in reply to a suggestion that a show be held in Pasdun korale, Mr. H. A. Samarakkody, Mudaliyar, Pasdun Korale East, says: "It is not possible to organize an Agri-Horticultural Show this year. Horticulture has been greatly neglected in this division, and steps are being taken by me to encourage the cultivation of vegetables and other fruit trees. To gain this end I have obtained permission from the Assistant Government Agent, Kalutara, to open out two experimental vegetable and fruit gardens, and early application will be made to you for seeds and plants. I think I will be able to organize a successful show in 1909."

Cotton.—Out of the supply of Sea Island and Egyptian cotton seed imported by the Society, 220 lb. Sea Island and 785 lb. Egyptian have been supplied to Branch Societies and members. The seed will be grown in Dumbara, Jaffna, Badulla, Katunayaka, Kandy, Marawila, Kegalla, Wanni Hatpattu, Katana, Hambantota, Peradeniya, &c.

Teff Grass.—A small supply of seed of Teff Grass (*Eragrostis abyssinica*)—a cereal suitable for dry regions—has been received through the courtesy of the Department of Mines and Agriculture, Sydney, N.S.W., and is being grown at the Government Stock Garden and other centres.

Improved Pomelo (Grape Fruit) from U.S.A.—The United States Department of Agriculture has kindly supplied the Society with seeds from selected specimens of the best varieties of this popular fruit, some of which are practically seedless.

Cassava.—Growers of this product will be interested to learn that the latest sales of cassava flour produced in Jamaica were at the rate of £14 per ton, c.i.f., Liverpool. It is stated that contracts are being made at this rate.

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* The last two, according to Benson, are identical, the name Mauritius being traceable to the fact that the Mozambique seeds reached India *via* Mauritius.

Logwood Seed.—In reply to an application made for a supply of this seed, the Secretary of the Jamaica Agricultural Society, writing on January 4, says: "All the logwood seed was attacked by a small weevil last year—a very common thing—and I did not get any good enough to send. The logwood is all in blossom now, and I have placed an order for some seed for you. I shall be able to send it by the month of March or April." The tree is a well-known honey as well as dye producer.

Indian Varieties of Arecanuts.—The seed nuts, ordered last year, are expected to arrive in a few days. A small surplus will be available in addition to the special requisitions received.

Saffiower (Carthamus indicus) and Zanzibar Castor Seed.—A supply of these is on the way out from India.

Castration of Cattle.—The annual report on the work of castration of cattle conducted by the Government Veterinary Department has been printed and circulated.

Publications.—A Tamil translation of the leaflet on Coconut Stem Disease, unavoidably delayed, will soon be out. A leaflet on "Transplanting and Manuring in Paddy Cultivation" has been issued since last meeting; one on "Tobacco Cultivation, Diseases, and Treatment" is now in the hands of the Printer.

Report on a Ceylon Sample of Eri Cocoons by Professor Dunstan.—"A sample of pierced eri silk cocoons was forwarded for examination. The sample consisted of about 1 oz. of silk cocoons, which varied in length from 1·5 to 2·5 inches, and were about 0·75 inch in diameter. The weight of single pierced cocoons varied from 0·3 to 0·57 gram; 28 per cent. were deep reddish brown cocoons, the remainder being white. The cocoons were long, irregular in shape, and pointed at one or both ends; they were soft, of loose texture, and generally pierced. The silk obtained from the white cocoons was usually of normal strength, whereas that from the red variety was weak. The diameter of the double fibre varied from 0·0012 to 0·0018 inch with an average of 0·0014 inch, whilst that of the single filaments ranged from 0·0006 to 0·0008 inch with an average of 0·00071 inch. Microscopical examiation showed the fibre to have the characteristic structure of 'wild silk.' These cocoons are of satisfactory quality, and could readily be carded and spun for the manufacture of 'waste' or 'spun' silk. Eri cocoons occur promiscuously in two colours, brick red and white. There was great difficulty in bleaching and dyeing the red cocoons, and it would therefore be advisable to eliminate these by selection of seed during about six successive rearings. The value of the silk would be considerably enhanced if the cocoons were obtained uniformly white. The silk from these eri cocoons could be utilized for mixing with Indian or Chinese Tussah silk, but the market value of the cocoons would vary considerably according to the demand for wild silk fabrics. The present value of the sample submitted was stated by experts to be about 1s. per lb. in this country. Cocoons of this type are used principally on the Continent, and are at present in considerable demand; but, owing to the small quantity sent for examination, samples could not have been submitted to European manufacturers. It is suggested that a larger sample of a few pounds of the cocoons, preferably of the white variety, should be forwarded, so that further inquiries may be made, and the commercial possibilities of these eri cocoons definitely determined." [A larger sample has since been forwarded, and a report is awaited.]

C. DRIEBERG, Secretary.

March 9th, 1908.

THE SUPPLEMENT TO THE

Tropical Agriculturist and Magazine of the C. A. S.

No. 3.] MARCH, 1908. [Vol. II.

PADDY (RICE) CULTIVATION IN CEYLON.

As bearing on the Reports which the Government promised during last Session, to obtain from the different Revenue Officers, on the Condition and Prospects of Rice Cultivation in their several districts and provinces, we have come upon an extremely interesting letter written by the late Sir Alexander Ashmore in 1890, when a comparatively unknown Assistant Agent in the island. It was signed "A." and addressed to the Editor of the *Ceylon Observer*, and upon the "pigeon-hole proof copy" which has lately turned up, we find our endorsement made at the time as follws:—"Is this not a very clever letter by young Ashmore of the C.C.S.?" No year is given on the letter; but by reference to our files, we find it was 1890 or some 14 months before Paddy Rents were abolished. It is a production which cannot fail to be read with interest not only by every member of the Civil Servive and every intelligent Ceylonese interested in rice cultivation; but also by all who recall the striking ability and vigorous personality of the late lamented Lieut.-Governor of the Colony. It will be found below.

In our editorial referenco to the above, on the day of its appearance, wo spoke of "the very timely and apposite arguments of 'A.' He knows all about his subject, he regards it from every-day experience and not as an outsider, and he turns the tables on local theorists by explaining the actual facts connected with the grain-growing industry over a large part of the country, in a way that deserves the careful consideration of all interested in the question from His Excellency the Governor downwards. We trust 'A.''s letter will receive such consideration." It will be observed that "Mr." Ashmore in 1890 took quite a cheerful, not to say optimistic, view of Paddy Cultivation in Ceylon as fairly remunerative to the people interested; and yet, curiously enough, he and Mr. LeMesurier were perhaps the only two Civil Servants who approved, and personally aided, Governor Havelock a year later in carrying out the wishes of Lord Knutsford in arranging for the abolition of the "Paddy Rents," the common plea used being the very small return from, if not tho unremunerativeness of, the industry.

PADDY CULTIVATION IN CEYLON.

Nov. 6th.

To the Editor of the "Ceylon Observer."

Sir,—A controversy has been for long carried on and still continues as to whether the cultivation of rice is a remunerative or an unremunerative industry. In a recent issue of your paper was printed a contribution thereto by a public servant who claims to have proved by an account of four experiments, over three of which he lost money, that the cultivation is a profitable one; while other persons have on other occasions published accounts of experiments by which they have purported to show that the cultivation of rice is the shortest and easiest road to ruin, or, as the case may be, the readiest route to the heaven of Mr Andrew Carnegie.

The present writer, who has never sown a grain of rice or turned a watercourse or cheated a renter, ventures very respectfully to submit to the parties to this controversy that they are shooting wide of the mark if what they wish to find out is not what the returns should be, but what to the ordinary unlearned agriculturist they actually are. In so far as the question is of other than academic interest, it is interesting only as the results will enable us to gauge and estimate the condition of the ordinary native inhabitant of the country. The question is interesting not as an agricultural but as a political problem, and as such it is solved by demonstrations which employ factors that are outside the lines of native usage. The Government Agent of the Eastern Province has tried his experiment with an English plough in his hand and an agricultural primer in his pocket; other

experiments and experiences of which accounts have been published, though lacking these advantages and differing among themselves in other respects, all agree in this that the system on which the labour has been employed and paid is different to that used in the ordinary course of native cultivation. If then what we want to find out is how the native agriculturist gets on in his native simplicity, and personally that is what we desire ; then and in that case our experimentalists throw no light on the question.

It has occurred to your correspondent, who has been pondering over the little results of so much misapplied ingenuity, and he is not a little vain of being the first person to make public so recondite a suggestion that the proper way to ascertain whether a native industry is remunerative is to enquire what classes of workers are engaged upon it, and to ascertain first the outgoings and then the distribution of the net proceeds, and he has thought that theso particulars, if correctly ascertained and reported, are likely to go further to throw light on the matter than the experiments of a whole college of agricultural instructors.

But before going further it would be well to define—it would have been of no small advantage to tho parties concerned to have done so earlier in the dispute—what precisely the question at issue is. Is or is not the cultivation of paddy a remunerative industry? Remunerative to whom ? The answer which is bound to come—"the goyiya"—is not sufficient, for Mr Elliott clearly is answering a question as if it referred to a capitalist landowner, and most of the other contributors to the discussion have done the same ; some appear by the 'goyiya' to mean the day-labourer to the exclusion of the landowner, and yet others (among them the editor of the 'Independent,') take him in his double capacity as landowner and labourer and do not hesitate to state that he makes nothing in either capacity.

Let us appeal for a moment to Political Economy. It is a maxim of that science, indisputed even in Ireland and probably unsuspected by the parties to this argument, that the three elements and the only three elements of production are land, labour and capital, the returns for their services received by the three co-operative elements being respectively rent, wages and interest. Our goyiya in his native simplicity may represent one, or two, or all three of the elements at once, and the returns he draws from the cultivation may be either wages only, or wages and rent if he is the landowner as well as the cultivator, or wages, rent and interest if he supplies from his own resources his seed paddy, and the other needful, if scanty, capital. The industry will be unremunerative if it returns to the landowner less rent than he would have obtained had he devoted his land to some other cultivation : unremunerative to the labourer if he draws less wages in it than he would have gained if he had devoted an equal quantum of industry to other pursuits : unremunerative to the capitalist if he draws from the capital advanced for employment in it a lower return than he would have obtained if it had been used in some other way.

It is then apparent that the question resolves itself into three ; and an endeavour will now be made, by a statement of the native practice in the employment of labour and the distribution of crop, to show how answers must be sought to those threo questions. It is to be premised that by the native agriculturist nothing whatever is paid for, neither the labourer's wage, nor the capitalist's interest, nor the landowner's rent, until the harvest is reaped, and that the wisdom of immemorial antiquity going before the wisdom of tho Education Department ordained that the labourer in the rice field, like the modern schoolmaster, should be paid by results. The system is this : All those persons who have had any share in producing the harvest being present, and the crop having been reaped, threshed and cleaned, the whole as it lies is divided as follows :—

(*a*) 1-10th gross crop to the landowner to meet his liability for the Government tithe.

(*b*) 1-7th gross crop, for the cost of reaping and threshing.

(*c*) $1\frac{1}{2}$ times the amount sown to the person who provided seed paddy—the supply of seed paddy being a privilege of the owner.

(*d*) Sundry small payments, for services rendered : huwandiram, measuring, the soothsayer, &c., &c.

After the above deductions have been ma , the balance is divided into three equal parts, of which the owner takes one (*e*), the person who supplied cattle (usually the owner) a second (*f*), and the cultivator the remainder (*g*).

Clearly (*a*) and (*e*) are rent, (*c*) and (*f*) the profits on capital, (*b*), (*d*) and (*g*) are wages.

If the crop fails wholly, no one gets anything ; but (*a*) and (*e*) remain a debt to be discharged out of the next harvest. If in part, the deduc-

tions are made in the order (*b*), (*c*), (*a*) and the balance, if any, distributed by tho rule. It must be remembered that this distribution is not the same for all fields, or for all parts of the country. The systems of distribution are many, but they are all on the same plan; the one abovo described is for a field yielding 10-fold: a common class of fields. Richer fields yield a larger, and less fertile fields a lower rent, the balance being divided in different ways. The less fertile the field the better the *apparent* though not the real wages: this being, of course, to meet extra labour in cultivation and increased risk of loss

It follows that among native cultivators, pursuing their cultivation in accordance with their own customs, the landowner gets a rent in kind exactly proportioned to the productive capacity of his land; the capitalist gets a certain and liberal interest on his loan, and a proportionate return, if successful, on that portion of his enterprise which he has entered on as a speculation; and the labourer a return in proportion to the success of his labours. But does the landowner thus get a less rent for his land than he would, if he cultivated it with some other product, that is, is the industry unremunerative to him? In Colombo the native paddy-landowner has turned his paddy-land into grass-fields; outlying corners of fields, unfertile or incapable of irrigation, are in the Western and Southern Provinces sometimes planted with coconuts: very rarely in old days the Kandyan planted coffee in his disused rice-field; but, on the whole, once a paddy-field always a paddy-field is the rule in Ceylon. Even the Jaffna Tamil who grows overything keeps his paddy-field for its accustomed use in its turn. Surely it is probable—the writer is not a philanthropist and will therefore not venture to dogmatise—that this is so because it is to the owner's interest; in other words because paddy-land owning is remunerative. For what is the alternative? That a very large body of persons, and no inconsiderable number of whom are wealthy, intelligent, and speculative, commence or continue to grow rice on land which could be more profitably employed otherwise because (*a*) it is the custom, or (*b*) because they are oppressed by unpaid headmen, or (*c*) because they think the cutivation of rico a more honourable pursuit than others. These are the only reasons that are ever offered us on the other side, and it is not for a seeker after truth to deny that they may have weight, but do they account for *all* the facts? A large body of persons—Sinhalese, Tamil and Malay—have migrated from Hambantota and its neighbourhood to Tihawa to cultivate rice. Was it under the influence of custom, or at the instigation of unpaid headmen, or in the pursuit of reputation, or did they hope to make and—for they are constantly being followed by others—do they make money?

Is that wealthy speculator Mr. de Mel seeking the bubble reputation at Muturajawela, or is he terrorised by a village arachchi?

Under the new Walawe irrigation work in the S.P., not yet working, 1,000 acres of Government land have already been purchased by private buyers: are they seekers of honour, slaves of custom, or victims of the Great Unpaid?

Are the rich Moormen who poured their money into the Government coffers in return for irrigable land in Batticaloa content with the mere name of landowner, or do they hope for a profit?

The local philanthropist tells us that they have engaged in the least remunerative of native industries. Have they, and if so why have they, or do they by any chance understand, their own business better than the local philanthropist?

And, now comes the turn of the capitalist. He need not keep us long; nobody ever wastes a tear on him. On his advance of seed paddy he gets 50 per cent. interest certain, and he may be trusted to be making a good thing over any other advance he makes. Let us leavo him and turn to the labourer. Does the labourer in the rice-field get more or less than a similar amount of work would earn for him in other occupations? No one can certainly tell; for though it is possible to measure his receipts, no one can measure the amount of his work, for the fact is this, that two or three days of arduous labour at the beginning once over, the rest consists of a hand's turn done at odd times and is by no means incompatible with the contemporaneous pursuit of other industries.

It is constantly stated in this connection that Sir C. P. Layard, a very high authority, expressed his opinion that labour in the rice-field was the worst paid of all labour. It is usual for the philanthropist and sometimes for less positive and better informed persons to quote, as nearly as he can remember them, Sir Charles' words and to apply them to both branches of the industry—but this is because he has never had them with their context in the original. The statement is, if the writer—who is far from books of reference—is not mistaken, contained in one of the earliest printed Administration

Reports of the Government Agents, W.P.* in the course of which an account is given of the improvement in the position of the peasantry following on the extension of the coffee enterprise. Mr. Layard, as he then was, spoke of the wages to be earned by Sinhalese as carpenters, cart drivers, fellers of jungle, &c., and he added, (the quotation is from memory): "Paddy cultivation is about the least remunerative industry in which a villager can engage." Too much has been made of this very moderate statement of an opinion, which went in fact no further than that, at a time when speculation was brisk and the coffee industry in the height of its prosperity on the borders of W. P., the stay-at-home agricultural labourer could make less wages by following his ancestral pursuits in his native village than he could earn by migrating to a place where business was brisker and by their plying such trades as he was fit for. It has no sort of application to the employment of the agricultural labour in ordinary times and at a distance from European centres of trade and speculation, and it does not refer to the landowner at all. But, that being so, the opinion so expressed, probably a correct one so far as it then went and in the place for which Sir Charles intended it, is not to shut out all further argument concerning consideration of the point? Let us try the question by such other tests as are at disposal.

What are the best known or least disputed points in connection with Sinhalese labour? They are these. That during the periods when paddy farming operations are in full swing it is impossible by the offer of any reasonable wages to induce the Sinhalese to engage in any other works and that no field in a fairly populous district ever lies uncultivated for want of labour. If these two undisputed facts are not to be accounted for by the remunerative nature of the work, what is the explanation? Why is it that, though the planter may want labour for his estate, the Government for the roads and the native employer for his plumbago pit, the owner of a paddy-field never lacks an *andakaraya*? Is it due, as we are told, to the tyranny of custom, the oppression of the unpaid headman, or the keenness of the villager in the pursuit of honour?

Or is it, *it seems possible*, that the villager likes best the work at which he can make most wages in the easiest and most congenial way? At least he himself never complains of the work but only that there is not enough of it.

Are we all quite sure that we know the villager's business, as we know that of the native capitalists, better than he knows it himself?—Your obedient servant, A.

* The statement was made in answer to our personal enquiry and embodied in a "Summary of Information" some thirty years ago, but "A's" argument is all the same very strong.—Ed.

Note by Ed., C.O.—Mr. Elliott, while in the Service, was quite as optimistic as "Mr." Ashmore as to Paddy Cultivation being profitable, at any rate in certain, districts. He read a paper before the local Asiatic Society in August, 1885, which created a good deal of discussion; but without going into that, we may quote the following summary as a text for the matter which follows showing the other side of the shield. Here is the substance of Mr. Elliott's paper:—

Mr. Elliott gave a detailed account of the modes of cultivation in the Matara and Batticaloa districts. The expenses of cultivation per acre he finds to be: in Matara, 36 days' labour of a man, and an outlay of 4 bushels of paddy; in Batticaloa, for munmari, 38 days' labour of a man and 8 bushels of paddy, for malamellama, 18 days' labour of a man and 10 bushels of paddy.

After giving some instances of exceptional crops in favourable localities, he stated that he considered 25 bushels as a fair average return from irrigated land.

With such a return, the average cost of raising a bushel of paddy ranges from 1½ to 2½ days' labour, while a return of 30 bushels reduces the cost from 1 to 1½ days' labour. But as all these estimates are based on outside rates of expenditure, he considers it may be fairly assumed "a day's labour produces a bushel of paddy."

Cents 25 is an outside value of labour in the rice-producing districts. Mr. Elliott is of opinion the enemies of paddy are few, and can be easily combated. The Paper also gave particulars of cost of transport from the producing districts—Batticaloa to the market at Jaffna. This amounts to 25 cents as cost of production, and transport 50 cents, and the paddy can generally be sold for R1·25.

The administration Report on the Kegalla district for 1885 was the authority quoted by a writer who criticised the above statement. The

very elaborate figures are published below, and Revenue Officers of the present day should study and compare the three very different deliverances there put before them. In connection with Sir Alexander Ashmore's deliverance on paddy cultivation in 1890, and the very different production also by a Civil Servant of the same period, it is of interest to note what the Hon. Mr. Fowler, C.M.G., said on this point, after Sir Henry Blake's recent lecture in London. We quote the passage bearing on "rice":—

"Mr. G. M. Fowler, C.M.G.:—There are thousands of acres of fertile land lying under tanks that have already been restored with the view of reviving the cultivation of rice ; but I am sorry to say the result has been a failure to a certain extent. It seems strange that the abolition of the Paddy tax did not lead to a vast increase in the area cultivated with rice : but that has not been the case. There has been but a small increase, if any, and I think the reasons are, first, that rice is not a remunerative crop ; and, secondly, that the people who cultivate rice are a very limited class—a class that gets smaller instead of increasing, owing to the spread of education. A so-called educated native considers it beneath him to do manual labour and it is no unusual thing for a father to be toiling in the fields to support in idleness his educated son while the latter is waiting for a post as clerk. Another reason is that when the Paddy tax was in force the headmen were greatly interested in extending its cultivation, for they received a commission on the tax collected by them. Now I am afraid their interest has greatly decreased. I should not like to be supposed to be advocating the reimposition of the tax, but I do think it a pity that vast areas of fertile land should be left useless in the vain hope that they may some day be utilised for paddy cultivation. If paddy will pay when cultivated, we may be pretty certain someone will cultivate it ; but if it cannot ay it is better that the land should be cultivated with some other product. Sir John Keane rather anticipated what I had to say about the utilisation of land under tanks ; but I fear that there is no more prospect of extension of rice cultivation in Ceylon than there is of wheat in England."

This is rather discouraging ; but we have evidence from several favourite districts of an eager desire to take up irrigated or irrigable land for rice cultivation in Ceylon.

(Extracts from Kegalla Administration Report for 1885.)

Cost of Production of Rice in Kegalla District.

The cost of the production of rice is shown in the tabulated replies to the following series of questions. I have taken a pela (i.e., about half-an-acre) as representing the extent owned by the ordinary villager :—

Questions.	Be Korale.	Paranakuru Korale.	Galboda Korale,	Kinigoda Korale.	Three korales	Lower Bulatgama.
For one pela (half acre) sown, how many pelas (one-and-a-quarter bushels) do you get at the Maha harvest ?	12	12	12	12	8	10
How many times do you plough? ..	3	3	3	3	4	4
Before the ploughings, how many days' labour of one man do you require for one pela, for turning the water on and off, clearing out Channels, repairing the ridges, kamatas, &c. ?	7	6	0	6	7	8
How many days' labour of one man do you require for one pela. for all the ploughing, &c. ?	6	6	6	6	8	8
How many buffaloes for all the ploughings? ..	6	6	6	6	8	8
How many days' labour of one man do you require for one pela for the sowing and the mammoty and smoothing work and ridge cutting connected therewith ?	11	12	12	12	8	8
How many days' labour of one man do you require for turning the water on and off, repairs, &c. and general supervision until harvest, that is seven months ..	24	21	29	21		21
How many days' labour of women (and children) do you require for weeding ? ..	20	20	17	15	14	10
How many days' labour for watching at nights?	22	15	14	15	17	25
do do fencing	4	4	3		3	4
do do reaping	7	5	6	6	5	5
do do heaping, tying and removing to threshing-floor ..	6	5	6	6	2	2
do for threshing and throwing on straw, &c. ..	7	6	6	6	6	5
How many buffaloes for threshing ? ..	6	6	5	6		
How many days' lahour of one man for heaping up the the pa dy. winnowing and measuring it ? ..	3	3	3	3	3	8
do. drying	1	1	1	1	1	1
do. removing crop to granary ? ..	1	1	1	1	1	1
Total number of days' lahour of one man required for one pela !	119	105	112	101	96	101
Total number of pairs of buffaloes for one pela?	9	9	8	9	11	10
	R c	R c	R c	R c	R c	R c
Market value of paddy per pela ..	1 50	1 50	1 50	1 50	1 25	1 25
Total average value of crop	18 00	18 00	18 00	18 00	10 00	12 50
Deduct seed paddy ...	1 50	1 50	1 50	1 50	1 25	1 25
Total ..	R16 50	16 50	16 50	165 0	8 75	11 25

Consequent value of each day's labour of one man (say) ..	14	16	15	16	9	11
Exclusive of cost of buffaloes at R1 per pair	9 00	9 00	8 00	9 00	11 00	10 00
And Government tax per pela ..	1 46	1 33	1 41	1 30	78	1 18
Total ..	R10 46	10 33	9 41	10 30	11 78	11 18
If hire of buffaloes and Government tax is included, the value of each day's labour comes to (say) ...	5	6	6	6	3	7-101

Notes.—(1)—There is scarcely any sale for straw in the Four Korales and Lower Bulatgama and only a very limited sale in the Three Korales where a pela's production of straw can sometimes be sold for from R1·50 to R2·00.

(2) The percentage of fields cultivated for the Yala is as follows:—Beligal Korale, 20 per cent; Paranakuru Korale, 10 per cent; Galboda Korale, 25 per cent; Kinigoda Korale, 25 per cent; Three Korales, 10 per cent; Lower Bulatgama, 5 per cent.

(3) And the yield in folds:—8 fold in Beligal Korale, 8 fold in Paranakuru Korale, 9 fold in Galboda Korale, 9 fold in Kinigoda Korale, 4 fold in Three Korales, 5 fold in Lower Bulatgama.

(4) The native rice is sold for from R2·52 to R2·75 per bushel.

(5) The cost of making two bushels of padd into one of rice is from 25 to 37½ cents.

(6) Buffaloes when hired are almost always paid for and so of course is the Government tax.

The "labour" is generally that of the family; when it is hired, it is paid for in food, *i.e.*, three full meals a day for a day's labour.

CEYLON'S TRADE REPORT.

(From the Chamber of Commerce Report on the half-year ended 31st December, 1907.)

TEA.—Total exports for the year of both Black and Green Tea amount to 182,023,732 lb.,—an increase of 12,114,397 lb., compared with the quantity exported in 1906:—

	1907.	1906.
Black Tea ..	176,117,016 lb.	165,899,399 lb.
Green Tea ..	5,906,716 lb.	4,009,936 lb.
	182,023,732 lb.	169,909,335 lb.

The increase is principally noticeable in shipments to Russia and the United Kingdom which have exceeded those for 1906 by 6¼ and 4½ million lb. respectively. Exports to Australia have increased by nearly ¾ million lb., and those to China, the larger proportion of which is destined for Russia and America, by rather over 1¾ million lb. as compared with the previous year's shipments. On the other hand direct shipments to America show a decrease of ½ million lb., and those to other countries collectively of ¾ million lb. as against 1906 exports. The last half-year has seen the gradual general improvement in quality previously noted well maintained, though latterly the good price obtainable for low grade teas has encouraged the offering of red leaf and such kinds. Finest flavoury teas have been well represented, and included some very desirable invoices from the Badulla side. Care in plucking and manufacture has been noticeable in spite of the temptation for a more liberal output, consequent on the very remunerative rates realised for lowcountry Teas. Prices have continued on a high level for the commoner and low medium growths, and also for Dusts and Fannings, the finest of these occasionally reaching almost record rates. Fine flavoury invoices have been in fair demand with prices on a comparatively moderate basis. The demand for Green Teas has been good, and the limited quantity obtainable has shown a very good average of quality. prices have been satisfactory, though without much change. The average price obtained at local auction was 41 cents against 35 cents in 1906.

RUBBER.—Shipments of Ceylon rubber during 1907 amount to 556,080 lb., as against 327,661 lb. exported in 1906, an increase of 228,419 lb. Of the total exports about 60 per cent has been shipped to the United Kingdom and 33 per cent to America, Germany and Australia being the next best customers. The market during the early part of the year was firm with buyers at R3·80 per lb., and then gradually declined to R3·25 per lb. towards the end of November. The chief feature noticeable was the price realised on the local market during the latter part of the year, as much as 6d to 9d over the rate ruling in London being paid in order to fulfil forward contracts. With the completion of these, prices dropped to a level with London. Medium and low qualities were in poor demand all through the year and difficult of sale.

PLUMBAGO.—A very marked decrease of rather over 3,000 tons is noticeable in the total exports of this mineral as compared with those in 1906, in which year it must be remembered shipments reached a record figure, the shortage being principally in shipments to Germany and America, while those to the United Kingdom have also been on a reduced scale. The following are the actual figures and their distribution:—

	1907. Cwt.	1906. Cwt.
To United Kingdom	170,133	187,672
,, America	283,393	3 9,898
,, Germany	97,689	127,253
,, Belgium	75,209	64,024
,, Other Countries	14,097	14,819
	640,521	703,666

The market ruled firm and steady, with a gradual hardening tendency until the latter part of the period under review, when the effects of the financial crisis in America began to be felt and caused a set back in prices.

PRODUCTS OF THE COCONUT PALM.—The following are the shipments for the second six months of 1907 compared with those for the corresponding period in 1906, viz.:—

	1907. July to December.	1906. July to December.
Coconut Oil	cwt. 314,712	cwt. 315,369
Copra	,, 250,537	,, 282,085
Coconut Poonac	,, 154,8·3	,, 159,860
Desiccated Coconut	lb. 13,413,884	lb. 11,513,167
Coconuts	nuts 8,082,171	nuts 7,143,419

The comparison for the whole of 1907 with 1906 stands thus:—

	1907. January to December.	1906. January to December.
Coconut Oil	cwt. 477,996	cwt. 539,070
Copra	,, 385,156	,, 451,184
Coconut Poonac	,, 228,199	,, 253,125
Desiccated Coconut	lb. 23,30·,497	lb. 20,213,570
Coconuts	nuts 13,813,147	nuts 13,013,510

from which figures it is at once seen that the exports of the produce of the coconut palm in 1907 were in every case, with the single exception of desiccated coconut, considerably below the quantities sent from the Island in 1903. This shortage in out-put is undoubtedly the result of a poor crop consequent on unfavourabl weather conditions in the preceding year. During th closing months of 1907 a good deal has been heard of - coconut stem disease affecting principally young trees. It does not appear, however, that short crops are in any way due to this pest, and it seems as if the short rainfall in 1906 was practically the sole cause of the smaller production. Early in 1907 coconut oil touched R585 per ton f. o. b., a record price for the article as far at least as the present generation is concerned, but from that point there has been a gradual decline in values, the year closing with tbe quotation of R375 per ton and a falling market.

POONAC—has been in steady demand during the year at from R80 to R90 per ton.

COPRA.—The demand for export has not been strong owing partly to other Copra-producing countries having had big crops, and partly to financial depression outside the Island, particularly in the closing months of the year.

CINNAMON.—Tbe quantity of Quills exported during 1907 is ratber under that of the previous year, but this slight decrease has been more than compensated for by the out-put of Chips, the total exports of both desciiptions showing an advance of 295,078 lb over those of 1906, and exceeding those of all pievious years. Germany continues to offer the largest market for both Quills and Chips, America being the next best customer for Quills and the United Kingdom for Chips. The market bas not been subject to any great fluctuations. Tbe rate for Quills in ordinary assortment at tbe commencement of the year was quoted at 48 cents per lb, and gradually advanced to 52 cents towards the end of June, declining towards tbe close of the year to about 47 cents. The market for Chips followed much the same course and after advancing to R65 per candy about the middle of the year gradually declined, and the rate quoted at the close of the period under review was R54 per candy.

COCOA.—Though Exports for the six months under review have been on a very much lower scale than those for the first six months of tbe year, they shew a material increase compared witb the corresponding period in 1906, Total exports for the year were 92,511 cwts. as against 54,020 cwts. in 1906, an increase of 38,491 cwts. The United Kingdom continues to be by far the largest market, and has taken over 70 per cent of the total shipments. The year opened with a strong market, the demand being in excess of supplies, with the result that local values steadily advanced. Common native descriptions were practically exbausted by the middle of March, but arrivals of estate qualities continued to come forward into May and found ready buyers. Tbe New Season's crop came in early in October, but the high prices prevailing rendered business difficult, as local values were still above home quotations. This position remained unaltered until late in the year, when producers were more inclined to meet the fall in the home markets.

CARDAMOMS.—Notwithstanding the reported reduced acreage of estate kinds, the exports of this article for the whole of 1907 bave exceeded those for tbe previous year by 57,359 lb. A heavy increase is noticeable in shipments to India as compared with 1906, wbile those to the United Kingdom have also been on a moderately increased scale. Exports to all other countries, however, show a decline. The supply during the first half of the year was scarcely sufficient to meet the demand, and as a consequence the local market ruled firm. With the arrival of son's crop towards the end of the year prices receded s owly, though they did not respond to the falls experienced n Europe and America, and business was consequently rendered speculative.

CITRONELLA OIL.—The exports for the year amount to 1,312,192 lb as compared witb 1,212,771 lb shipped during 1906, but the difference is hardly sufficient to account for the extraordinary fluctuations in prices that have prevailed during the year. On referring to the Chamber's Report for the first half of the year, it will be noticed that from R1·05 per lb in January the market rose steadily till as much as R1·20 to 1·24 was quoted in April, after wbich it declined to R1·02 to 1·05 in June. At the end of August tbe price had fallen to 90 to 95 cents, and each month shewed a further decline, the market closing at the end of December at 50 to 54 cents. It is probable that the financial difficulties experienced in the United States and America assisted towards the rapid decline, as the exports to America which were as much as 623,999 lb. in 1905 and 563,030 in 1906 have fallen to 479,024 for the year.

The following is tbe distribution of exports for the two years :—

		1906.	1907.
United Kingdom	..	483,533	520, 31
France	..	18,975	32,900
Germany	..	97,396	198,109
Australia	..	64,(65	68,402
America	..	541,030	479,024
Other Couutries	..	7,772	13,426
	lb.	1,212,771	1,312,192

THE COMPARATIVE STATEMENT OF EXPORTS.

		1907. Jan, to June.	1907. July to Dec.	1907. Total,	1906. Total.
Black tea	lb.	94,210,493	81,906,523	176,117,016	165,889,391
Green tea	lb.	2,655,944	3,250,772	5,906,716	4,009,939
Rubber	lb.	24?,37?	313,710	556.080	327,?66
Coffee	cwt.	1,635	214	1,819	7,472
Cocoa	,,	60,661	31,850	92,511	54,020
Cardamoms	lb.	433,159	346,336	789,495	732,136
Cinnamon bales	lb.	1,264,391	2,093,557	3,358,448	3,367,692
Cinnamon chips	lb.	1,410,3?3	1,425,6?3	2,835,936	2,531,614
Coconuts	nuts	5,730,976	8,082,171	13,813,147	16,013,510
Desiccated coconuts	lb.	9,889,613	13,413,884	23,303,497	20,213,570
Coconut poonac	cwt.	73,376	154,823	228,199	259,125
Copra	,,	134,619	250,537	385,156	451,134
Coconut oil	,,	153,284	314,712	477,996	539,070
Citronella oil	lb.	682,540	629,652	1,312,192	1,212,771
Cinchona	,,	150,287	84,212	234,499	297,613
Plumbago	cwt.	369,087	271,434	640,521	703,666

IMPORTS.

PIECE GOODS.—A fair trade has been done during the past six months, although it bas been difficult to work up prices sufficiently to show a margin on the high level of prices current in the Home markets. The trade would appear to be in a healthy condition, tbough towards the end of the year the forced realization of stocks in certain quarters has had a tendency to depress prices. A feature of the trade has beeu the absence of demand for Dhooties, for which there is usually a strong inquiry during the last six months of the year. The grade of cotton known as "Mid Uplands" was quoted on tbe 1st July at 7·22d per pound, and on the 31st December stood at 6·18d per pound.

RICE.—Imports for the six months ended 31st December, 1907, shew a decrease of 133,488 bags, as compared with the corresponding period in 1906. Arrivals during the first

half of the year were, however, 228,394 bags in excess of the landings for the same period in 1906, and total imports for 1907 have exceeded those for the previous year by 91,906 bags.

	1907.	1906.
Rice ..	3,406,641 bags	3,311,735 bags

Prices, which have been on a high level throughout the year, indicated an advance about the middle of the period under review, but declined again towards the close of the year.

RICE IN BURMA.

The area under rice cultivation in the fifteen principal rice-producing districts of Lower Burma is now reported to be 7,292,211 acres. Reduced areas are reported from several of the more important districts, and the reductions in the district estimates of the outturn have reduced the provincial estimate. The total fallow area is shown as 523,760 acres, and the area destroyed stands as 70,684 acres. The surplus available for export is estimated at 2,486,000 tons cargo rice, equivalent to 42,135,593 cwts. of cleaned rice.—*M. Mail*, Feb. 25.

THE LIFE OF TEA BUSHES IN INDIA.

With reference to the life of tea bushes in India, the "Times" publishes the following letter from "X": "In your article of December 20 upon the production of tea it was stated that the bushes in India are capable of lasting for a very long period, but no specific instances of endurance were named. As the matter is one of special importance, I send you information that has reached me in the course of investigation. It fully confirms what was said. From Assam I learn that the oldest tea at Chubwa, put out in 1837, was still vigorous in 1902, aged sixty-five years, when the China bushes were replaced by a finer jat of plant upon which labour could be more profitably employed; while I hear of tea in the Tingrai district planted by Bruce, probably about 1840, which is still being worked. In Darjeeling the bulk of the old tea, which is still being cropped dates from 1865 back to 1860, while there are small plots at Lebong planted in 1856 and 1857 still bearing well. In Cachar and Sylhet some of the bushes first planted at Doloo about 1858 have been cultivated without interruption up to this season; at Arnicherra there are small areas planted in 1857 still being worked; some of the old tea around Lulleecherra planted about 1858 is now in bearing, and part of Goolni made in 1864 is yielding well. In Dooars the earliest tea is at Dam Dim and Hohe; it was planted in 1873 or 1874. In Travancore the oldest, dating from about 1883, is still vigorous and healthy, some field yielding as much as 700 lb per acre. To these statements of fact I append opinions received from planters of exceptional standing and exprience respecting the probable-life of the gardens. "The measure of endurance of the tea plant on Indian soil is dependent entirely on how both are treated. As planters we cannot claim to have been quite fair to the tea bush until recent years." "I would most certainly say that the life of a garden planted and worked under present conditions would be much longer than one planted thirty to fifty years ago. We know now that young tea must be allowed to arrive at maturity before it can be regularly plucked and pruned." "There is no reason why the tea in Travancore, which is at present twenty-four years old, should not increase in yielding capacity, and there seems to me no reason why it should not live another fifty years, probably longer, provided it is well treated." "I have such respect for the tea plant that I believe, properly treated, it would live longer than the oldest man."—*H. & C. Mail*, Jan. 31.

THE A.B.C. OF BEE CULTURE.

This book has since 1877, when it first appeared, held its place as *the* standard work on Bee-keeping, but the present enlarged edition, which has been thoroughly revised and brought up-to-date, must replace all previous ones as a regular *vade-mecum* on the subject. Arranged alphabetically, dictionary-wise, there is no conceievable point connected with apiculture that the authors (Messrs. A. I. and E. R. Root) do not refer to and satisfactorily explain. With the "A.B.C." in his possession the amateur will never be at a loss. That over 100,000 copies of the work are already in the hands of bee-keepers all the world over is a sufficient guarantee of its value. The present edition will add another 15,000 to this number. The new edition consists of 600 double-column pages and as the publishers announce is "bountifully supplied with many excellent illustrations." At the end is a most interesting Picture Gallery of apiaries and bee exhibits. The work has already been translated into French and German. And yet—such is American enterprise—this Encyclopædia, which might more appropriately have been named the "A to Z of Bee-keeping" is available at the modest price of 1 dollar and 50 cents per copy.

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LACE-MAKING IN COTTAGE AND FACTORY.

AN INDUSTRY THAT EMPLOYS THOUSANDS.

By E. A. L. Douglas.

Dr. Johnson described net, the mother of lace, as a texture "woven with interstical vacuities." If he were here today to consider the cunning in-workings through which nets evolve with the help of machinery into lace, and to observe the variety and scope of their generation, he could, filled with the spirit of modernity and its metaphorical truthfulness, define lace as the" bread and butter of a great number of the British people." The lace-making industries of Great Britain give steady work to thousands and thousands of the population. And, not only that, they are increasing year by year, and receiving wider recognition throughout the world, doing much for the national prosperity. Further, they give work that is safer, more hygienic and more appropriate for the employment of women than perhaps any other industrial occupation in the kingdom. Accidents are exceptionally rare. In the last statistics available the fatalities in the combined lace, silk, and hosiery factories are stated as the fewest of all the British Industrial work-places —there having been three for the year, the next lowest being eight.

Much of the work connected with the lace factories is done by women in their own homes. Among other things, after coming from the looms, the lace must be bleached, dyed, dressed, starched, ironed, mended, measured and carded. From whichever point of view it may be regarded the captains of industry have every reason to regard their lace factories with complacency. The maids and matrons of industry also, on their part, can look on the revival of the beautiful old point and pillow lace craft as the greatest blessing which has ever come to the cottage folk of the Midlands, of Devon, and of Ireland.

NEARLY A TOWNFUL OF WORKERS.

In Nottingham alone there are more than 187,500 people engaged in the lace trade. Yet Nottingham does by no means monoplise the lace business. Much lace machinery is constructed there, and sent out to neighbouring towns and other districts, where vast factories employ many people. The greatness of the lace industry permeates the life of Nottingham. It may be called the keynote of its existence. The School of Art and the university there appreciate its importance to such an extent that they devote special departments to the designing of lace, dyeing, etc., and to the construction and working of lace machinery. They even hold evening classes for the express benefit of the artisans. An authority, who speaks of the Nottingham looms as "marvellous triumphs of ingenuity," says: "If we wonder at the work of the lace-makers (real-lace workers), it may be of even greater wonder that human intelligence should have compelled steam and machinery to do so nearly the same!"

One of the pleasing features of the lace trade is the fact that, instead of being rivals, the makers of real-lace and the manufacturers of machine-made lace work together for greater trade, each appealing to distinctly different classes for distinctly varying purposes, and each benefiting the other.

A RESULT OF THE FAMINE.

All the lace industries in Ireland (except the Carrickmacross and Limerick industries) were developed as a direct result of the famine years of 1846-7-8. Most of them grew out of the tireless efforts of brave women, who, single-handed, and with nothing but bits of old lace to guide them, taught the intricate stitches to the starving women and children, and thus gave them an able weapon with which to combat the terrors of their poverty.

A solitary nun in Youghal, haunted by the pinched faces of the wretched children who attended the convent school, one day found a piece of old lace, and was inspired with the idea of teaching the poor how to make it. Her teaching was so thorough that the laces then adopted and originated are acknowledged today to be among the most exquisite of all laces. In much the same manner Mrs. Roberts bade the poor crochet-workers of Clones copy some Point de Venise lace, and succeeded in having it bought and worn by the fashion-leaders of New York, Paris, Brussels and Vienna. The curious and wonderful work of tho Cork lace-makers was taught by the Ursuline nuns. A scrap of old lace found in the Tynan rectory was the beginning of the beautiful Irish point laces in the Venetian, Spanish, and rose designs, adapted by the peasants of that desolate country on the borders of Lough Erne. A flounce made by them, bought by Lord John George Beresford and exhibited in 1851, brought many orders.

Ever since those terrible famine days lace-making has been of the most signal benefit to the Irish cottagers. The delicate Tambour lace-work dates from 1829, when one C. Walker brought twenty-four girls from England to teach the women of Limerick. The Limerick appliqué was introduced by Lady de Vere, and the dainty Carrickmacross lace, which consists of a pattern cut from cambric and applied to net with point stitches, was originated by the wife of the Rector of Dunnamoyne in 1820. This lady taught her servant, Mary Steadman, to copy some lace she had brought from Italy.

WINNERS OF MANY AWARDS.

The skillful lace-makers of Beer and Branscombe have won many medals for their beautiful Honiton laces—among others, the bronze medal at the Chicago Exhibition of 1892, the silver medal at Paris in 1900, the Grand Prize at St. Louis in 1904, and the "Diplomed'Honneur" at Milan in 1906. The gold cross of the Home Arts and Industries has been won by them three times. The industry in these villages, revived in 1890, was handed over in 1891, to Miss Trevelyan whose great aunt, Pauline, Lady Trevelyan, had done much for the lace workers in 1866, when there was a great deal of distress among the cottagers. At the present time a steady output of high-class lace could be maintained if only a wider market were created. Only the best linen thread is used and the delicate fillings and net groundings of the exquisite old designs have been revived, and new designs suitable for the finest quality of work introduced. Some of the fine raised work consumes an almost incredible length of time in the making. Four hours' uninterrupted work, in some cases, is hardly perceptible.

Nearly all Continental laces are made of cotton. In the cottage industries of England and Ireland the use of cotton thread has been almost entirely supplanted by the finest qualities of linen thread. The even beauty of good lace depends on the worker's touch, and this light, delicate touch can only be acquired by the use of the best linen thread.

Apart from all other considerations, lace-making, both in cottage and in factory, is worthy of the public interest, from the fact that it is every year becoming more distinctly national in character. As an occupation for women and girls it is, as already mentioned, singularly congenial—and this fact is significant in a country where so many women are obliged to support themselves. In the cottage work it has the highly disirabe effect of keeping the rural classes on the soil.—*Daily Mail*, Jan. 21.

PETROLEUM RESIDUE FOR THE EXTERMINATION OF WHITE ANTS.

Colombo, Feb. 24th.

DEAR SIR,—We attach herewith copy of a letter written from Java describing the methods adopted in a successful experiment in exterminating White Ants which should prove of peculiar interest to tea planters in Ceylon. We hand it to you as you may consider it sufficiently instructive and interesting to publish in your valuable paper—We are, dear Sir, yours faithfully,

DELMEGE, FORSYTH & Co.

(*Copy*

[*Extract from the "Indische Mercuur" of 30th July, 1907.*]

AN EXPERIMENT WITH PETROLEUM RESIDUE FOR EXTERMINATION OF WHITE ANTS.

The above named experiment was made in the tea gardens of the "Landen aan de Zuid" estate, near Tasik, Malaya, during five consecutive weeks. The recipe was received by the under-signed from the Zoological Department of the Agricultural Department in Buitenzorg near Batavia, Java). It has to be done as follows:—Put together 1 to 1½ liqueur glasses of residue oil and one small bottle of water, sprinkle the mixture round the tree, shaking the bottle all the while. I took

winebottles for the purpose, containing about ¾ liter, because these bottles had not to be filled so often as the small sort, which hold only ½ liter. The bottles are closed by a cork, which has been pierced sufficiently to let a straw stalk pass. The content of one bottle is sufficient for the treatment of 15 to 20 shrubs. Before the real disinfection began, the stems of the teaplants, which had suffered from white ants, were freed from these insects by means of a pointed piece of wood, the covered corridors in the bark were destroyod, and especially the holes made by them and already quite full of earth were cleaned. Then the ground, about 4 inches from the root and also the scars on the tainted wood were very well wetted by the mixture. Constant shaking of the bottle is necessary in order to sprinkle as much as possible with water, containing the above-mentioned quantity of residue. On several spots in the gardens small experiments were made. Everywhere the results were the same, to wit: On a field, used for the experiment, there were 800 shrubs on the 15th April. Among these, 311 had suffered from white ants; they were all treated in the way described and marked by means of a stick. During the following days the tainted plants as well as the healthy shrubs were carefully examined,. Of courso there were always some of the latter that were visited by ants, but it happened very seldom that a treated plant suffered again from them. In those cases, it was no doubt due to the ground near the root not being sufficiently sprinkled with oil. Indeed, it is very difficult to judge whether the quantity of oil, poured out with the water, is sufficient. Only afterwards, when the water is evaporated, one can clearly see the stains on the ground left there by tho residual oil. After a month, there were nearly one hundred new plants attacked on the experiment field, whilst only a dozen plants could be counted, which, after having been treated, had again suffered from the insects. This proportion is striking.

By and by, however, the disinfecting liquid loses its power, either by evaporation, or the washing away of the oil. So I came to the conclusion, that having treated the shrubs like this one can protect one's plants for about one month. Of course handy people are required for the work, as, should the sprinkling be carelessly effected, one cannot rely upon the results. It seems to me, that women are most adaptod for the work, but still good superintendence is essential. Very probably the oil poured over th root, the ground and the bark, doos not affect tho plant in the least. Even after having treated a shrub very often for about a month, I could not see the slightest alteration in its appearance. Therefore it seems to me, that the proportion of water and residue may safely be taken somewhat larger. During the time, in which the experiment was taken, there fell a lot of rain (500mM), and only on 10 days it was dry. So far as regards the experiment; but I would like to make some statements in connection with this question. They say that in the dry season the termites are more active in their work of destruction above the ground. In that time, the oil is less likely to be washed away, so the results are perhaps better then, though the evaporation may make chances equal again. I often heard people declare that ants only attack those trees, as are already ill or in a weak or abnormal condition. I cannot contradict this theory, because I do not know enough about termites, and was not able to read anything on the subject. Still my experience compols me to have a different opinion, as I have often seen ants attack perfectly strong trees and shrubs, but it is truo that the holes, scars and corridors of already attacked plants are very welcome to them, as these places help them to complete their work of destruction. Anyhow, I believe that the discoverer of a not too costly means for the extermination or driving away of white ants will be a benefactor to the tea plantation-owners on low grounds, and I have deemed it necessary that modesty, originating from my short experience, ought not to keep me from publishing this article in a perodical, which appeared to me to be most suitable for the purpose.

P. Holten.

THE FERTILIZATION OF LAND.

In *The Daily Argosy* of Tuesday, Mr. C. Ross, of Gold Mines, Essequebo, writes :—

As any natural means of fertilizing the land must bo of much interest to those engaged in the cultivation of the soil, I will with your permission refer to a plant which attracted my notice in 1896, when I was the manager of Plantation "Success," Leguan.

I observed that the growth of the canes on the field, number twenty-four in the "White Swan" section of that estate, were much in advance of those on the other fields in the same section and planted at the same time, the difference being so remarkable that I decided to try and

ascertain the cause. On inspectieng the field I found that large numbers of plants of the indigo family were growing in that field but not in the others. Knowing that the indigo plant was regarded by the planters of the past as an excel-lent "green dressing" for the soil, I had some of the plants saved when weeding the field. Those plants when they were from one and a half to two feet high blossomed at the ends of the branches in clusters of light blue or pink in colour, and curled back like the tail of a hare when running. The leaves of the plant are rough and almost round of a light green colour and when they are bruised throw off a strong smell of musk. After the blossoms had run to seed, I drew up several of the plants with their rocts and found that many of them had small white globes suspended by white thread-like roots and attached to the main roots. The globes were about the size of a grain of barley and with slight pressures be-tween the fingers they crumbled into a fine white powder. I am under the belief that this powder possesses marvellous fertilising power on the soil. Had I remained in the sugar business it was my intention to make experi-ments with the plant. Now I would suggest that the Imperial Department of Agriculture should make experiments with the plant to acertain its value. The plant is among the spontaneous growths in this colony and is found in most of the West India islands and experi-ments could be made at small expense as the plant could be cultivated among the young canes with much advantage to the latter. Before closing I should state that some years before the plant attracted my attention, some of the largest branches of plantains and finest ground provisions I have seen in this colony, were grown on land where the plant under notice grew as a weed. I would therefore suggest that those engaged in the farming business should try and establish the plant in their farms. I am, sir, etc.

C. Ross.

—*Weekly Argosy*, Jan. 11.

BANANA TRADE OF DUTCH GUIANA.

Reuter's Agency is informed that, following the example of the British and Colonial Govern-ment in Jamaica, the Dutch Colonial Govern-ment are taking energetic steps to encourage banana growing in Dutch Guiana, where, as was the case in Jamaica, the decline in the price of cane sugar has made it difficult for the plan-ters to pay their way. The Dutch Colonial Government have advanced money to the growers to enable them to plant bananas and have granted a subsidy for ten years to the Royal Dutch West India Steamship Company for a weekly service of suitably fitted fruit steamers between the ports of Paramaribo and New York.—*Financial News*, Feb. 27.

COCONUT, RUBBER AND OTHER TROPICAL PRODUCTS.

IN THE SOLOMON ISLANDS GROUP.

A New Development Company.

The Solomon Islands Development Co., Ltd., with a capital, £100,000 in 1,000 shares of £100 each is being formed to acquire lands, principally in the Solomon Islands Group, and to develop them by the establishment of plantations of coconuts, rubber, bananas, fibres, and other valuable tropical products. It will also take power in its Articles of Association to engage in any other business incidental to the Islands. 200 Shares, equal to £20,000, have already been applied for by persons who are acquainted in-timately with island conditions. When 300 shares, equal to £30,000, are allotted the Com-pany will be considered as formed. The estab-lishment of Coconut Plantations is to be the main object of the Company, as being the surest and most easily worked source of revenue. The Company, however, do not propose waiting seven or eight years until the Coconuts mature for the payment of dividends; but, taking ad-vantage of the regular steam service under Commonwealth Mail Contract, they purpose planting Bananas and other products between the young coconut trees; and as these plants mature quickly, profitable business with Aus-tralia should be attained after the second year, probably enabling dividends to be paid, whilst development work would still be going on at capital cost. A block of 10,000 acres of rich agricultural land on the island of Gaudal-canar has been applied for on a 999 years' lease, and only awaits the formal approval of the High Commissioner to be available for work. A valuable plantation of about 8,000 acres at Manning Straits, embracing a number of small islands partly planted, has been purchased on behalf of the Company. This is one of the best situated properties in the Solomon Islands and is looked upon as a very advantageous purchase, both by reason of its situation, the nature of its soil, the value of the improvements already placed upon it, and the fishing rights, especially for Turtle Shell, from

which an appreciable revenue is expected to be derived. A freehold purchase has also been made of the island of Tetipari, or Montgomery Island, estimated at about 40 square miles (25,000 acres), with about 8,000 to 10,000 acres suitable for coconuts, and the balance forest country, containing much valuable timber, to be exploited at a convenient time. Other freehold purchases of land are being negotiated at suitable spots. In offering these properties for flotation the Provisional Directors wish to state that everything being offered at actual cost, no profit whatever is made by anyone in the formation of the Company and the Shareholders will reap the full benefit of the cash purchases made and of the application for lands now under consideration by the British authorities.

The Provisional Directors are :—Col. James Burns, Hon. James Inglis, Adam Forsyth, Esq., and Walter Lucas, Esq.

THE CHINA TEA CAMPAIGN.

Paragraphs have appeared in some of the papers to the effect that "the imports of Indian tea during the past eight months seem to have diminished about 9 per cent., while China tea has more than doubled as compared with the corresponding period of 1906-7." On this subject Messrs. McMeekin and Co., Lime Street, send the following statement, which explains the position : "The imports of 'old-fashioned China Congou' are insignificant in volume. It is true that the imports of what is in the statistics termed 'Congou' from China were nearly double during the last eight months, as compared with the corresponding eight months of the previous year, but the tea embraced in the term 'Congou' includes large quantities of exceedingly low quality, which is at the present moment almost unsaleable. While the lowest qualities of Indian and Ceylon teas have been realising in public auction about 7¼d. per lb., it has been almost impossible to dispose of the commonest grades of China tea at 4d. per lb. The consequence is that stocks in the bonded warehouses of this class of tea have materially increased. The importations have no relationship to the duty collected by the Chancellor of the Exchequer, as the teas go into bond and duty is only paid upon delivery therefrom for home consumption. The increase in the amount of duty collected from China tea of every kind during the year 1907, as compared with the year 1906, amounted to about £77,000 (out of a gross total of £5,700,000). The percentage which China tea of all classes showed to the total consumption within the United Kingdom during the last five calender years is as follows : 1903, 5¾ per cent. ; 1904, 4¼ per cent. ; 1905, 2½ per cent. ; 1906, 2 per cent. ; 1907, 3½ per cent. The increase shown during 1907 is attributable to the effort made by distributors to use in their blends more of the inferior China tea to try and compensate for the higher prices ruling for Indian and Ceylon growths. That an increase of only 1 per cent. could be made in such circumstances indicates how exceedingly unwilling the British public are to take even the smallest percentage of China tea in the blends that are sold from retail shops."

By the way, the friends of China tea, and there seem to be quite a number of them, are becoming a little anxious about the supply of rubbish arriving from China. In the "Grocers' Gazette" "Heathen Chinee" writes :—"This market has been temporarily paralysed and demoralised by the launching upon it of vast quantities of the most terrible rubbish in the shape of siftings which the trade has seen for many a year past. The fact that this deleterious mixture pays 5d. per lb. duty to the Customs just the same as if it were really tea must supply the only possible excuse for letting it into the country. In the long run this will be another nail in the coffin of the China trade, and the veteran hands who still live by and love the old trade are the most bitter in invective against the latest knock-out blow. Many of us can still remember the days of the old Maloo mixture, and it took years and years to rid the market of that awful pest. What eventually became of it, no one exactly knows to this day, but it was before the era of most litter, and so was probably used for bedding down purposes for horses and cattle when straw ran dear, or perhaps to keep strawberries out of the dirt. Now, once again, just when we are priding ourselves on the whole community drinking better tea, along comes this reeking rubbish in the shape of siftings to once more discredit China tea in the eyes of the whole world. The best friends of the China tea trade are the men who are anxious to see it keep up to at least a moderately good standard of quality, and, goodness knows, the trade does not want any more 'facers' just at the moment."

After this very candid statement it is amusing to note that the secretary of the China Tea Association winds up a letter to the trade journal we have mentioned, with the following touch of humour : "China tea, of all grades, does not

profess to contend with Indian and Ceylon 'in rich syrupy liquor,' but it is satisfactory to know that indulgence in the China leaf, whether whole or broken, will not lead to an inquest, as in a recent case where the deceased was found to have a leather-coated stomach from the use of strong astringent teas." We may now expect to see advertisements of China tea with the following addition: "Use tea from the Flowery Land and avoid a leather-coated stomach."—*H. and C. Mail*, Feb. 14.

THE COCONUT STEM DISEASE.

Feb. 21st.

Through the courtesy of Mr. Welldon, the V. A. of the Ceylon Tea Plantations Co., and of Mr. Braine, the Superintendent of Mawatte estate, I had the privilege of witnessing a demonstration of how to treat trees affected with the disease. Without being hypercritical, I must be permitted to enquire, why have all these demonstrations on estates, and why on those of a particular Company? If it was necessary to have demonstrations on estates, one of those chosen should certainly have been Goluapokuna, where the most complete precautions are being adopted to guard trees against infection. The spraying operations would have been an object lesson, though not for the ordinary villager, yet for the intelligent planter. Goluapokuna, withal, would have been more central and more accessible than the estates chosen. But I am very strongly of opinion, and have urged those opinions constantly during the last few months, that it is

THE SMALL LAND-OWNER THAT SHOULD BE REACHED PRIMARILY,

and not the more intelligent owners or Superintendents of estates. However, all this by the way. I learnt from Dr. Willis, to whom I communicated my opinion, that a very complete scheme has been elaborated, and will be adopted and carried out immediately. This should have been done at the initial stage of the epidemic, but better late than never. Much lost time will have to be retrieved. The interest the intelligent portion of those interested in coconuts evinced in the demonstration was amply testified to by the distance from which planters came to witness it. There were planters from far-off Rajakadaluwa, who travelled all night so as to be present at 8 a.m. A gentleman came from Henaratgoda. Those engaged in desiccating nuts were present with

DISEASED KERNELS OF NUTS,

and nuts with a fungus attack almost similar to the disease on the stems, affecting the husk. But the numbers present were disappointing. As for the natives, only two solitary outsiders were there, one a Headman and another a man apparently of some standing. The people that should have come were not there. Stolid, Philosophic, apathy must have been one cause, and the inaccessibility of the place another. Now to the demonstration. To me, who has to deal with old trees on which the attack is superficial and never penetrates the hard wood, unless possibly when treatment is neglected, it was a revelation, and an unpleasant revelation, to see the extent of the damage that could be done on young trees. One part of the tree operated upon was badly attacked, and I was not surprised to find

THE HEART COMPLETELY DECAYED.

A bleeding spot above that was chosen and cut out, and there was the disease wending its way almost up to the crown. What was strange was, and I am sure it was a revelation even to Mr. Petch, that the disease on its way up, was almost imperceptible in places and was indicated only by slightly discoloured tissue, while above that, dead tissue was met. This occurred more than once. This is a *very* serious state of affairs and demands imperatively prompt and vigorous action on the part of the authorities. At the request of Mr. Welldon, I addressed a few words to the Sinhalese present. The Peace Officer at once stated that very few Sinhalese would cut out the diseased tissue as completely as he saw done. I told them that

AS IN THE CASE OF HUMAN INFECTIOUS DISEASES,

the Government will be compelled to step in and interfere both for the safety of the individual concerned and for the public safety. An Ordinance had been passed for this purpose, and will be proclaimed in infected areas. The owners of gardens and estates will be called upon, by notices served on them, to treat their trees. Failure to do so will be followed by the trees being cut down and burnt, and the individual prosecuted. I asked them what a Sinhalese man will do without his coconut trees? He will prefer death to that, he said. Neglect of timely precautions will end that way, I replied. I questioned Mr. Petch, as to how he innooculated trees and sucessfully infected them. He explained that he cut out a square piece

of the bark, placed some of the exuding matter from the diseased part of a tree inside, replaced the piece of bark and protected the cut with grafting wax. I pointed out to him that according to his theory, infection was

CARRIED FROM TREE TO TREE BY CLIMBERS, SQUIRRELS AND POLE-CATS.

They will not adopt so elaborate a process of innoculation, but will simply carry a small portion of the bleeding stuff on their bodies, and place it on the bark or in a crevice in it. I suggested that he should try infecting trees according to the upposed natural means of infection. If he succeeded, his theory will be established. I told him I saw a young tree infected through smooth bark, on which no crevice was apparent to the naked eye. Later in the day, I visted an estate in the Negombo District, where I was shown a tree that was attacked with the disease a long time ago and was treated. The tree was an old one. Above the treated portion the bark was dead and loose for about 10 feet. I think this shows that the disease cannot penetrate the hard wood of old trees. One always meets with trees with dead and loose bark, which may have been owing to the disease before it attracted attention. I was asked by Mr. Welldon how I accounted for

TREES WITH HOLLOWED OUT CENTRES

that one meets with always. I replied, it may have been caused by this disease when it was sporadic and did not, therefore, arrest attension. Now it had assumed a virulently epidemic form and must be stamped out.

Hot tar should be applied to the cut-out portion of a diseased tree. In how many cases is this done? When one is by, it is done, not otherwise. An idea has occurred to me to obviate this. An iron bucket of about half-gallon capacity should be made with a fire place underneath, something like the cans "Teythanni" men (itinerant tea vendors) use. Pieces of fuel can always be put into the fire-place, and the tar will always be hot. I make a present of this idea to the engineering firms n Colombo. The demand for these, if moderately priced, will be very large.

B.

THE COCONUT BLEEDING AND OTHER DISEASE.—I.

Veyangoda, Feb. 24th.

SIR,—Mr. Petch's letter, published in Friday's *Observer*, will be very widely welcomed for the very plain and definite instructions it contains on the treatment of coconut trees suffering from the stem disease. It was long needed. It is also valuable because of the reasons it puts forth why certain suggested remedies must fail to afford the desired relief. The enforcement of the official remedy may be expected to follow the recent proclamation of the disease under the Pests Ordinance; but voluntary measures, whether preventive or curative, are always to be preferred to compulsory, as saving time, money and friction. At any rate, let people first be sought to be convinced of the good that is intended, before compulsion is brought to bear on them. To judge from "B." 's letter in Saturday's *Observer* no such attempt was made in connection with the demonstrations last week—else he would not have had to act as interpreter. Surely, the Revenue Officers and Headmen should have been widely informed; or, if they had been informed, some of them at least should have been present. I quite agree that Negombo is more central and important than Mirigama and there should be no difficulty, as I believe is intended, in choosing centres with reference to population and plantations. I shall be glad to give every possible help to Dr. Willis and Mr. Petch in their efforts to inform the villagers in this neighbourhood—not 2 miles from the Railway Station.

The long-looked-for rain came down in delightful showers on Saturday afternoon and measured nearly two inches. The drought extended over five weeks, as, barring a cent on 29th January, the previous rainfall was ·26 of an inch on 16th of that month. Last night there were gentle showers. The coloured leaf-bud in cinnamon bushes had foretold the rain for days past. It is almost always a precursor of rain.

F.B.

II.

Kandawela, Negombo, Feb. 23.

SIR,—I was glad to see in the local papers of 21st and 22nd instant, Mr. Petch's clear instructions as to the preparation of Bordeaux Mixture for the Bleeding disease. It is now over 3 years since attention was drawn to the bleeding disease affecting the coconut palm by a letter from Mr Nicholas in the *Observer* and by sections of the stem being sent to the Kachcheri by the headman of Uswetakeiyawa (Negombo Canal), and only now, after the pest has become general, have the directions been published in the newspapers how to treat the affected trees and prevent further spread of the disease. But Mr. Petch does not explicitly tell us in his letter what to do with the

Bordeaux Mixture. I do not propose to criticise the remedial measures recommended by Mr. Petch, the Government Mycologist, but a paragraph in your issue of the 18th instant says :—"There is hardly an ounce of Sulphate of Copper (the chemical recommended to be used by Mr. Petch) left in Colombo."

As the Government authorities have been so long in advising us what to do, the pest meanwhile spreading far and wide, and establishing itself so as to be almost ineradicable now, is it too much to ask the Government to come now promptly to the aid of the coconut proprietors by speedily importing sufficient quantities of the salt (Sulphate of Copper—*Palmanikkan*) to be sold at reasonable rates (not above what was lately the market price, R28 per cwt. or 25 cents per lb.)

As for Deemig pumps, &c., I think, the majority of the natives will be satisfied with the ordinary whitewashing brush and an earthen chatty while a coconut tree climber can use to apply the mixture from top to bottom of the tree, *if it be recommended that the whole tree* be made immune.

But what about the *nuts*, which are apparently directly affected through the husk by this fungus. Should these also be painted over—and when? It is now over 6 months since I first drew attention to the fact that the nuts were also attacked by the fungus, and as yet no *report* has appeared from Peradeniya bearing on this development of the disease. I have ascertained that even the nuts of perfectly healthy trees are liable to be attacked, and have sent a fresh specimen of such an affected nut in husk to Peradeniya.

I am sorry that I was not permitted to exhibit some specimens of diseased nuts, or rather nuts attacked by the fungus, to His Excellency when he came to Negombo on Friday for the express purpose of seeing for himself the ravages of the fungus. Why it was not deemed desirable that the Governor should be shown the specimens I cannot understand—it would not have taken up more than a minute of his time. All I can say is I know this also is spreading more and more and the attacks of the fungus appear to be increasing in virulence. *Bud Rot.* This is far more serious than any fungoid attacks, as no remedy has been found, the rot proving invariably fatal to the tree. No external signs of the disease (for this is really a disease) are manifest until the rot has proceeded far enough to cause the shrivelling of the nut in husks and their subsequent dropping to the ground. The withering thereafter of the branches and the bending over of the crown of the tree is only a matter of a few *days*.

I am afraid, Sir, this dire disease is spreading in the Island. Mr. Petch tells me it has occurred in the Kurunegala district. I understand that it has also appeared in the Batticaloa district. Mr. Wright, of Mirigama, has had a few cases. Mr. Nicholas and I thought we saw five cases along the coach road, judging by the bending over of the crowns and the appearance of the branches, and I informed Mr. Petch on Friday that a Sinhalese gentleman, S. D. Cornelis, has had some 10 cases at Andiambalama (near Minuwangoda), and Waring Bungalow Estate (near Golua Pokuna). Considering the gravity of the position and the enormous interests involved, both the Government and the native population, Sinhalese and Tamil, being largely interested in the coconut, areca and palmyrah palms (the latter of which also showing liability to attack, and I believe also the kitul) do you not think, Sir, we should ask the Indian Government to lend us the services of Dr. Bulter the eminent Imperial Mycologist, who is an authority on fungi, and who has made a study of the diseases of the coconut palm. Investigations carried out by him here in Ceylon will also be of service to South India.

JOHN D. VANDERSTRAATEN.

DRIED BANANAS FROM CEYLON.

A French correspondent, writing us from Bordeaux on 14th February, says:—I know for a fact that some of this product (dried bananas) has been exported and sent to the London market from Ceylon, but I have found no reference to it in the list of exports from your island. am told that the trial shipment to England did not find favour there, but since I have ascertained that a regular trade could be made here and in Northern Europe with an article well preserved and packed up—both edible, and also dried for the purpose to be turned into flour. Do you know of any firm engaged in this business? As cacao growing requires plenty of shade afforded by banana trees, this last fruit, if well treated, could be exported in large quantities.

THE DISEASE IN THE COCONUT STEM.

IMPORTANT LECTURE BY MR. T. PETCH.

Necessity for Concerted Action.

OFFICIALS, PLANTERS, AND VILLAGERS MUST CO-OPERATE.

A Re-assuring Discussion.

The Lowcountry Products Association was furthering an important work in its chaperonage in the Public Hall, Colombo, on 7th March, of a paper on "The Coconut Stem or Bleeding Disease," read by Mr. T. Petch, Government Mycologist. There was a large attendance, the audience including many prominent coconut growers in the island, a number of whom showed their appreciation of Mr. Petch's effort by showering upon him question upon question when the discussion had ended. The paper expatiated at great length upon many points of vital importance to the "grower," and the type of inquiry subsequently indicated the general anxiety that is felt that nothing of usefulness in coping with or preventing the "disease" shall be left undone.

The lecturer's paper was distinctly reassuring, and inspired listeners with confidence that if co-operative action is taken by the few officials, the numerous "planters," and the still more numerous villagers, in the way of obtaining and supplying accurate reports upon the varying prevalence of the disease, the trouble will not extend to unforeseen distressful dimensions

Mr James Peiris, Chairman of the Association, was somewhat late in arrival, but Mr. F. C. Loos presided in the meantime. In introducing the lecturer, he said:—Gentlemen, it is quite by accident that I happen to be in the chair. Our Chairman, Mr. James Peiris, has not arrived but I expect he will come later, when I shall vacate my position. One of our principal industries—the coconut industry—is threatened by a very serious disease. There is a good deal of alarm about it, but at the same time I think the alarm is greatly exaggerated. I hope it is so. This afternoon Mr. Petch, than whom there is no more capable man in the Island, will deliver a lecture on that disease.

Among those present were :—The Hon. Mr. F. C. Loos, Hon. Mr. John Ferguson, C.M.G., Messrs. Rudd, J Hæmmig, A. E. Rajapakse Mudaliyar, Chas. Pieris, J. Clovis de Silva, C. Drieberg, J. VanLangenberg, W. Dias Bandaranayake, G. S. Schneider, A. Y. Daniol, C. Boven, H. L. do Mel, T. Muttucoomaraswamy, Solomon Seneviratne, Attapattu Mudaliyar, Drs. Gerald de Saram, H. M. Fernando, W P. Rodrigo, and V. Saravanamuttu, Messrs. L. B. Fernando, F. J. de Mel, Jacob de Mel, C. P. Seneviratne, Johannes de Mel, A. Bawa, F. Morgan de Saram, A. K. Beven, J. P. Fonseka, T. E. de Sampayo, A. J. R. de Soysa, C. Namasiwayam, S. D. S. Gunasekera, C. D. Carolis, W. Felsinger, Rajendra, and Arsecularatne.

At the end of the hall Messrs. Walker, Sons & Co., Ltd., and Messrs. Brown & Co., Ltd., had on view collections of agricultural implements—knives, hatches, pumps and sprays, implements used for the treatment of the disease. On one of the verandahs were several specimens of diseased parts of coconut trees and an arecanut palm, supposed to be suffering from the stem disease. Specimens of diseased nut kernels were also on exhibition.

MR. PETCH'S PAPER.

A COMPREHENSIVE SURVEY OF THE DISEASE AND ITS TREATMENT.

I will not waste your time by recapitulating the history of this disease. If you will refer to the *Tropical Agriculturist* for December, 1906, you will find what was known up to that date.

It is more important at the present time, when so many theories are being propounded, to explain why and how it has been decided that the disease is caused by a fungus, and is not due to electricity in the atmosphere, or poisons absorbed by the roots, or anything else.

In the paper referred to, it was stated that a fungus had been found in the decaying stem and that it was probably the cause of the disease. There was some doubt, because bacteria were also found, but this did not alter the con clusion that it was a stem disease, not a root disease. It was admitted in the paper that the point could only be decided by pure cultures, and this admission provided an opportunity for some officious remarks regardless of the fact that its decision would not make any difference in the treatment. That, today, is the same as in 1906.

In 1906, I was not in a position to undertake pure cultures satisfactorily, and thereforo inoculations were made with diseased tissue, in order to prove that the bleeding was a sign of disease. The tree inoculated was an old one, and there was apparently no result. In 1907, a fresh series of inoculation was made, with diseased tissues on a young well-grown

tree about 15 years old. I was able to get a good supply of material with the fungus actively growing in it, because I found a planter who did not object to cut down a diseased tree when it was in good bearing. I made four inoculations. One of these was spoilt, the infecting material being pulled out, probably by squirrels or rats. The second was made with the yellow decaying tissue in which the fungus is growing most actively; the third was made with the dark brown tissue in which the fungus has stopped growing but has left spores; the fourth was made with the liquid squeezed from the inside of the decaying stem. These were examined three months afterwards in the dry season. The second has bled fairly strongly, and shows a streak of red-brown liquid about six inches long; the third and fourth have bled slightly. The control cut has not bled. This proves that the disease can be transferred from one tree to another by inoculation with the diseased tissue from the stem. It proves, therefore, that it is

A Real Disease

and not an effect of bad drainage, or too much manure, or too little manure. And it proves that it is a stem disease, not a root disease. The next step was to grow the fungus in pure culture, that is to separate it from other fungi and bacteria, and to infect a tree with its spores. Part of the diseased tissue obtained for the last experiment was placed in glass dishes and the fungus was allowed to develop. As the tissue had been exposed, other fungi and bacteria grew at the same time. Now, if inoculations were made with spores from these dishes, there would be a danger of introducing these other fungi, and it would be impossible to tell which caused the disease. We must therefore obtain a cultivation of one fungus only. To do this, a solution of gelatine and sugar is boiled until all the organisms in it are killed; it is then poured into sterilised dishes and allowed to cool. The spores of the diseased fungus are then transferred to the gelantine with a sterilised needle, and the dish is kept covered so that no other spores can blow into it. If this culture produces two or more fungi, it is still impure, and the spores of the one required must be taken from it when it fruits, and sown in another dish. The process must be repeated until a culture is obtained which is clear of all other fungi or bacteria. This is not a long process in the case of the fungus of the coconut disease. In the first place, it grows very rapidly and fruits earlier than the other fungi which get into the first culture accidently: and secondly, it produces its spores, in one form at least at the top of small upright columns so that they can easily be removed without touching the gelatine. The second cultivation is, with reasonable care in manipulation, free from other fungi and bacteria.

Inoculations were made with spores from one of these cultures. The tree was a fairly young one, but rather stunted and therefore denser than the last. There was no bleeding at the end of three months, but when one of the infected spots was cut out, it was found that

The Disease Had Extended

for about 12 square inches. A month later, another spot infected at the same time began to bleed.

Returning to the old tree, infected in 1906, —the infected places were cut into this year, and it was found that the tissues had decayed round the infections for about 4 inches, but the decay did not extend into the hard wood. This confirms the opinion that the disease as a rule does not penetrate the dense wood of old stems. There is yet another point before the proof is complete. We must recover our fungus from the infected trees in order to prove that the decay is not caused by some other fungus which has got into the trees after our inoculation. Part of the diseased tissue was cut out of the infected trees, and placed in sterilised dishes: these pieces produced the fructification of the fungus within two days.

We find therefore that the decaying tissue of bleeding trees contains a fungus; that when the spores of this fungus are inserted in a sound stem, the stem decays and bleeds, *i.e.*, we reproduce the symptoms of the disease; that the artificially diseased stem contains actively growing plants of the fungus which we put in. Two of these trees are still infected, and they will be left in order to see what the final effect of the fungus is. These infections are made by cutting a piece of tissue out of the stem, inserting the infected tissue or the spores of the fungus, replacing the outer half of the piece cut out, and then covering the cut with grafting wax. In the control experiments, exactly the same operations are done, but the infecting material is omitted. The experiments must of course be made on healthy trees, and, if possible, in a locality where there is no disease. All the cutting must be done with a sterilised

chisel. The wax prevents the entrance of other fungi, but it is a drawback in the present case, because it hinders the bleeding. The control experiment shows that the diseased effect is not produced by merely cutting the tree. As usual, this method has been criticised and another suggested, but anyone who has the slightest knowledge of inoculations will recognise that it is the normal method, and the only one which will give any reliable results. To attempt to imitato naturo by brushing the spores on the exterior of a tree

Is Absolutely Worthless.

Infections must be localised and controllable. My object is to prove that the disease is infectious, and to do that tho inoculation must be made under the most favourable conditions in order to secure results as soon as possible. Suppose the spores are brushed over the tree: the weathor conditions may be unfavourable to germination and the experiment may result in failure time after time. And if the disease does begin on that particular tree, there is no means of knowing whether it is produced by those spores or others which have arrived there later. The proof that the disease is a stem disease and is caused by a fungus is complete. There are many other points to be enquired into, but they are chiefly of scientific interest. At present, what is most required is the adoption of the treatment recommended fifteen months ago. With regard to the use of Bordeaux mixture,—I should not apply this to old trees, say over thirty years old. The fungus attacks these very slowly, and it can be detected before it has done much damage. Youngor trees should be sprayed to prevent infection. A correspondent suggests that "people after spraying or painting their seemingly uninfected trees will be unable to combat the latent disease which will not be discovered till the tree is killed." There is not much fear of this: Bordeaux mixture will not prevent bleeding if the tree is diseased. The same correspondent wants to know: (1) How many feet of coconut trunk the 50 gallons of Bordeaux mixture will suffice for? (2) What is the "stronger" solution for? (3) Would not painting with a brush be more effective than spraying and prevent waste of the mixture? With regard to the first point, about a pint should suffice for the trees which are most in need of spraying, that is the young trees. It depends how much the cooly wastes. (2) The recipe for Bordeaux mixture was published to correct the advice of one of the newspapers that the lime and copper sulphate should be mixed to the thickness of paint. The "stronger" solution mentioned in my letter gives the limit. I should use the weaker, *i.e.* the ordinary strength. (3) The cost of labour is usually the chief item in making and applying Bordeaux mixture. Brushing the solution over the trunk would probably waste less than spraying, but it is entirely a question whether the saving in solution will compensate for the extra labour required. It is a matter for experiment on the estate under ordinary estate conditions. Several correspondents have taken the trouble to write to me and point out improved recipes for Bordeaux mixture. Bordeaux mixture was invented about 30 years ago, and people have been trying to improve it ever since. The literature of the subject would fill scores of volumes. Every year some one brings out a mixture which is more exact from the chemist's standpeint, or which works more quickly, etc., but not one of these stands the test of actual practice. The United States Department of Agriculture, with its army of chemists and botanists, still pins its faith to the old formula. I may point out to my correspondents that it is my business to know what has been written on such subjects. I was surprised to find recently a coconut estate on which all the fallen fronds and husks were burnt. It was almost

The First Clean Coconut Estate

I had seen. Now, when I recommended burning prunings on tea estates, I ran counter to many people's ideas of manuring. I have quoted the advice of the American Department of Agriculture with regard to cleaning up coconut estates, and I consider that it is a necessary part of disease work. Whethor the fungus of the stem disease will live on the usual rubbish round a coconut tree is a point I will decide during the next rainy season: but from an ordinary sanitary point of view, I should prefer to see all such rubbish burnt. Of course, I interfere again with the manuring problem, especially with the question of nitrogen. Burning all rubbish is supposed to involve an enormous loss of nitrogen. In this connection, however, I must ask my critics not to quote against me the amount of nitrogen contained in fresh or dried fronds and husks, but to find out how much of this nitrogen ever becomes available for the trees if the husks and fronds are allowed to decay on the surface of the ground. This is a problem which has never been worked out for the Tropics. By the way, Kainit has no special fungicidal properties; I have had forwarded

to me samples of manure—special rubber mixture— with fungi growing on them. True, they were harmless fungi, but they serve to prove the point. The fungus of the bleeding disease is not likely to live on such a mixture : it requires sugar.

Some of those who witnessed the demonstrations given recently were astonished at the amount of excision required in the case of young trees. There is no doubt that, as in the case of cocoa canker, the first treatment will entail a considerable amount of work : afterwards it will become part of the ordinary estate routine. The bleeding has been known to occur for years but it has not been recognised as a disease and has been allowed to proceed unchecked. Even in last July the existence of a real disease was denied by the majority of coconut planters. And even now many appear to be waiting for some one else to do their work. Many people have rushed into print over this disease without taking any trouble to ascertain what has previously been said or done. One cannot be always correcting their mis-statements, but I think it is time that some of them were pointed out. For example, "we have today to regret that the Peradeniya Department, although aware of the stem disease for two or more years ago, took no steps to study it or to warn the country against its propagation." Well, I knew of the bleeding in May, 1906, and a full account of the disease as far as practical details go, was written in October and appeared in December, 1906. It was open to coconut planters to begin treating the disease in the year in which it was first reported. "Now it transpires that the industry is menaced by a nut disease, and . . . Bud Rot, yet we have not heard that the Botanic Department has either studied or taken any steps to combat them." The writer will find that a circular calling attention to Bud Rot was issued in April, 1906, and every case reported to the department has been visited immediately. I have known of the nut disease for a month : it will be investigated as soon as certain operations in connection with the stem disease have been got into working order. "It is not difficult for the Peradeniya staff in their zeal for literary and scientific studies to postpone their practical application." This, as applied to the present case,

Is the Exact Reverse of the Facts :

the practical part was known in 1906; what is being added now is more of the nature of a scientific study. "The treatment suggested to combat the disease is not that of Mr. Petch. He endorsed what was being done in the Maha-oya Valley." The treatment was recommended by me to the Katana Society in May, 1906. I knew nothing then of what had been done in the Maha-oya Valley.

"For all that this scientific staff has so far done it may be non-existent (1908). . . The Katana Agricultural Society drew attention to this disease. Nothing was done. It enlisted the sympathy of the late Mr. Jardine, at whose representation Mr. Petch went to Katukenda and examined the affected trees. He reported that he could not say what the disease was. He saw a certain treatment carried out and suggested its continuance." It is not true that nothing was done in the first case and the remainder of the paragraph is a misrepresentation. In fact, we have to deal here with a campaign of misrepresentation.

The disease was reported to me in May, 1906. The locality was visited and the present treatment was recommended. It was not possible to work out the cause of the disease from the trees seen there, and I could not get any further information of other localities. Meanwhile, I worked out the Hevea root disease. It was reported again from Galle in October, 1906. This locality was visited in October, and an account of the disease, attributing it to a fungus and stating that it was a stem disease, was written in the same month. This was published in the *Tropical Agriculturist* for December, 1906, six months after my attention had been called to the bleeding, and within a month after it had been decided that it was likely to be a serious disease. Here it may be remarked that, as regards the prevalence of a disease, we have to rely on the information supplied by planters. Many cases of what might be serious diseases are dealt with without the knowledge of the general public because they are unique.

Practical instructions for the treatment of the disease were given in 1906. Letters were witten on the subject in 1907, a lecture was given in August when it was evident that the majority of coconut planters did not believe there was any disease, and a circular was written in September. Inoculations from pure cultures of the fungus were made in October and proved successful in January, 1908. I give this last fact for comparison only : it does not affect the treatment recommended in 1906. In view of these facts, I maintain that the delay in treatment is not due to the mycologist.

Much of this criticism arises from a misconception of the duties of a mycologist. It is his duty to find out what is causing the disease, and to prescribe remedies. In the course of that work he will visit estates to obtain facts and material, but he cannot possibly visit every estate. And when a disease has been investigated and a remedy recognised as sufficient, it rests with the planter to apply it, because the mycologist must pass on to other diseases. Some people appear to think that the mycologist will go down and carry out the actual treatment. If your Medical Officer of Health advises that certain drains should be cleaned out, you do not expect him to come and do the work. Again, the mycologist spends his time over the diseases which are reported to him, and in proportion as they are reported: it is

Absolutely Impossible for him

to travel round the country searching for unknown diseases, and at present he has quite enough work sent in. He is not an inspector of nuisances, and he has no power to enter on any land or order anything to be done. It has been suggested that the Indian Department of Agriculture should be invited to investigate this disease now that most of the facts are known. Purely, in self defence, I quote a brief history of the palm disease of the Godaveri Delta:—"September, 1904. Brought to the notice of the Government. August, 1905. District visited by the mycologist. There was no doubt that a disease existed because in some places 70 per cent. of the trees were dead. October, 1906. Accounts of the disease published, and remedies prescribed. October, 1907. Successful infections with the fungus." I am sorry to say, gentlemen, that I have had to devote the last half of this paper to a personal explanation. I shall now be very happy to answer any question which you may wish to ask.

The Discussion.

Mr. S. Weerackody, Mudaliyar:—Is it sufficient if the diseased parts are cut out only and the wounds not burnt or tarred?

Mr. Petch:—You must cut out the whole of the diseased tissue. You then leave a huge wound in the stem for the fungus to go in again. I do not think it advisable to leave the wound uncovered. Then the question is what sort of cover would be best. If you burn the wound without covering it you only take out what little is left of the disease after cutting out. Burning is necessary because you cannot get the tar to stick on the wet wound.

Mr. Weerackody:—What is the best time to cut out diseased parts—dry or wet weather?

Mr. Petch:—You will have to go on doing it whether in rain or sun. (Laughter.) The best time, however, is in dry weather.

Mr. Weerackody:—Supposing in the case of a young tree you burnt the wound and it dried, would not that suffice?

Mr. Petch:—No.

Mr Weerackody:—I noticed bleeding from wounds for some days after treatment.

Mr. Petch:—I should prefer the burning to be done the same day. If the wound bleeds again it means that the work has not been done well. If you get out the whole of the diseased tissue I don't think there would be any bleeding.

Mr. Weerackody:—I noticed a tree about thirty years old and about 20 feet of the stem was riddled with holes which exuded juice. Can such a tree be treated?

Mr. Petch:—You can treat it. You can cut out the whole of the outside of a tree without killing it.

Mr. Weerackody:—The whole of the bark has been cut out in this tree to the hard wood and left as it is without being burnt or tarred.

Mr. A. K. Beven:—In such a case will you advise the removal of the whole of the bark? I have a tree barked up to 24 feet.

Mr. Petch:—You will have to treat it in that fashion.

Mr. Beven:—Will there be any harm?

Mr. Petch:—You must cut out all the diseased tissue. The only alternative is to cut down the tree and destroy it. Somehow you have got to get rid of the diseased tissue on the outside.

Mr. Beven:—As regards young trees I noticed wide cracks opening in the cut-out portions inviting

The Red Beetle to Enter.

Mr. Petch:—The wood of the interior of a young tree is sappy and when you expose it to the sun and air it will crack.

Mr. Beven:—Is there any treatment to prevent this cracking?

Mr. Petch:—Not that I know of.

The Hon. Mr. John Ferguson:—I suppose the alternative in the case of a badly diseased tree is that it should be destroyed? If left alone it will not only die but would be a danger to the estate.

Mr. PETCH :—Certainly.

Mr. FERGUSON :—Did I hear you say "imported" when referring to this disease?

Mr. PETCH :—No; I consider you had the disease as long as you had the coconut tree.

Mr. FERGUSON :—Do you think that the sowing of local seed nuts results in the disease?

Mr. PETCH :—No.

Mr. FERGUSON :—Will you recommend at this stage to anyone planting coconuts to get seed nuts from elsewhere?

Mr. PETCH :—No.

Mr. FERGUSON :—Is the disease in the Godavery district the same?

Mr. PETCH :—It is different.

Mr. FERGUSON :—Is that disease in the island?

Mr. PETCH :—No.

Mr. FERGUSON :—It is not allied to bud rot?

Mr. PETCH :—Not allied. Though it attacks the same part of the tree it is entirely different.

Mr. FERGUSON :—And is caused by a fungus?

Mr. PETCH :—Yes.

Mr. FERGUSON :—In the case of rubbish on coconut estates, should not the application of lime to such rubbish save the risk of infection through such heaps?

Mr. PETCH :—Yes.

Mr. FERGUSON :—You prefer burning the rubbish?

Mr. PETCH :—Yes. It is a question for experiment as to what proportion of lime

Will Stop the Growth of the Fungus.

Mr. FERGUSON :—From what you have heard and seen, do you consider the disease has extended since your attention was directed to it in 1906?

Mr. PETCH :—I think it has scarcely extended, but now everybody is on the look-out for it.

Mr. FERGUSON :—Have you heard lately much about bud rot?

Mr. PETCH :—We have only had one case sent in since last August. There have only been three cases ever reported at Peradeniya.

Mr. FERGUSON :—To counteract the adverse criticism, and much of it is unnecessary criticism, to which you have referred today, I have today heard of a gentleman who was able to discover the bud rot disease from your report at a certain time. He at once destroyed the tree and has not been troubled since, so your writing has not been altogether thrown away. (Hear, hear.

Mr. WEERACKODY :—May I ask whether the fungus of the bud rot disease and that of the stem disease are the same?

Mr. PETCH :—They are not the same; and are quite different fungi.

Mr. WEERACKODY—(handing a slip of paper with the name of a plantation): Is that the estate you visited for bud rot?

Mr. PETCH :—Yes. We cut down and burned the trees affected. We saw a group of trees which had bud rot. There were cases which were undoubtedly bud rot; and there were other cases which we thought doubtful, but we put down the whole lot and burned the tops.

Mr. WEERACKODY :—That estate was first planted with Liberian coffee and subsequently fully planted with coconuts and tea. The surface soil had been scraped off and the trees were standing on gravelly soil. Could that be a reason for the appearance of the disease?

Mr. PETCH :—No. There was a case in Dumbara in dark soil. Soil conditions have nothing to do with bud rot, which is caused by a bacteria.

Mr. WEERACKODY :—Have you enquired into the leaf disease of the coconut?

Mr. PETCH :—The spots on the leaf are caused by a blight similar to the Grey Blight of tea, practically all over the Island. The damage is practically nothing.

Mr. WEERACKODY :—I have a small garden, and the coconut trees in it are affected with a leaf disease which I tried to eradicate for three years but failed. It appears to get worse. The leaves are dropping, and the nut bunches are broken and hanging.

Mr. PETCH :—I do not think that is a leaf disease. You had better write to me particulars and I will come and see the trees. The coconut leaf disease is found all over the Island, and it is not worth doing anything to. It is perfectly harmless.

Dr. H. M. FERNANDO—remarked, with reference to the stem disease, that a larger percentage of cases on old estates than on young was to be found. Did not that show that the disease had been in existence for a great number of years?

Mr. PETCH :—Yes, but I don't like to hold to your percentage in every case.

Dr. FERNANDO—said that the Society would be glad to supply Mr. Petch with any information that was necessary. The Society would be glad

if Mr. Petch could suggest what information planters could submit to him.

Mr. Petch—said that he hoped soon to have an organised force for

Working at the Disease,

and one of the duties would be to get important details from the districts in which the men are at work.

Dr. Fernando :—Planters could co-operate ?

Mr. Petch—said there were two ways in which planters could help him. They might give returns of the trees affected together with the acreage. Of course names would not be published in these cases. By this means they would be able to discover how much disease was spreading. If the planter treated his own trees and made himself solely responsible that everything was in order on his estate the planters might go round and see whether the villagers in the same neighbourhood were treating their trees, because information of this kind was necessary, and it was practically impossible for one man to gather it from such an area.

Mr. Ferguson :—The treatment you recommended has been uniformly successful ?

Mr. Petch :—I do not know any case where it failed.

Mr. Ferguson :—Do you consider an otherwise diseased palm more liable to get this disease than an ordinary palm, and that the effect of weakening would make the tree more liable to catch the disease ?

Mr. Petch :—There is nothing, no facts, to show that particular trees are attacked. Young, healthy trees are attacked.

Mr. Ferguson :—That was the same with the coffee leaf disease. Young trees took it as readily as the old trees, the worn out ones in the island. It began in one of our youngest planting districts not in one of the oldest.

Mr. H. L. de Mel :—Have you traced tho death of coconut trees to this disease only ?

Mr. Petch :—No. The only possible case is supplied in the trees shown me on the Negombo Canal. And those cases I doubt very much. There is a patch of trees at Kochchikade, diseased, that looks as if the trees would die soon. But I cannot say I have seen trees actually killed by this disease.

Mr. H. L. de Mel :—Is there a chance of the disease killing trees ?

Mr. Petch :—Yes, I am surprised I havo not found trees killed by it. I found the disease growing within a foot of the cavity and yet such trees were in bearing.

Mr. A. E. Rajapakse, Mudaliyar :—I saw trees at Kochikade dead and dying.

Mr. Petch :—They are not dead.

Mr. Rajapakse :—Several of those trees are now dead.

Mr. Petch—On the piece of ground over which you took the Governor ?

Mr. Rajapakse :—Yes. Several trees have died, some of them very old, about 50 years of age.

Mr. Ferguson :—You have not had your treatment questioned scientifically ?

Mr. Petch :—No.

Mr. Ferguson:—Nor by any practical planter?

Mr. Petch :—No. I should be glad to go down and see any cases where it has not proved successful.

Mr. W. S. Bandaranayake :—In the case of trees badly diseased that are too good to be cut down entirely, will the cutting off of diseased tissue and tarring only suffice ?

Mr. Petch :—I am afraid we cannot allow it. When cutting out portions and tarring cannot be carried out the only alternative is to

Cut Down the Tree and Burn It.

This will have to be done in accordance with the Pests Ordinance.

Mr. Bandaranayake :—Do not healthy trees stand the disease better ?

Mr. Petch :—No. Trees which stand the disease best are the old ones which have dense wood within an inch of the surface. If they had not that dense wood the fungus would go right into the centre.

Mr. Bandaranayake :—Will the burying of coconut husks be dangerous?

Mr. Petch :—I will examine husks in wet weather and see. The burying of husks carrying the fungus will be as dangerous as leaving them above ground.

Mr. Ferguson :—Has your attention been called to the kernel disease of the coconut ?

Mr. Petch :—Yes, I intend to go into the matter as soon as we can get into working order in connection with the stem disease. It must be done on the spot. Several nuts have been sent to me to Peradeniya, but when they got there nothing could be done with them. There are too many other organisims on the kernels after some days. They must be investigated on the spot.

Mr. Felsinger :—In the matter of application in the stem diseaso, which is better—tar or carbolic acid ?

Mr. PETCH :—Tar is better, something that is waterproof is desirable.

Mr. FELSINGER :—The effect of carbolic acid is felt deeper.

Mr. PETCH :—If it goes deeper than tar there is a decided disadvantage. In the coconut tree, unfortunately, if you make a hole, it does not fill up through growth. In cacao or rubber it is otherwise. So if you make an opening in the coconut tree you must make the surface impervious to water. Cyllin or carbolic acid or anything similar will not make it waterproof.

Mr. FELSINGER :—What about a mixture of carbolic and tar? The effect should be better. The carbolic would work on particles of diseased matter left and the tar act as a waterproof coat.

Mr. PETCH :—The mixture would be too expensive. You do not want to kill the tissues; and you use tar to prevent water effects.

Mr. FELSINGER :—Carbolic will kill the fungus.

Mr. PETCH :—If you get at it. But you cut out the fungus and apply tar.

Mr. F. J. de MEL :—Can this fungus grow on jak trees?

Mr. PETCH :—It thrives on sugars. The bleeding on jak trees is not caused by this fungus.

Mr. F. J. de EL :—It is very much like this.

Mr. PETCH :—It is the result of decayed bark: and is a well-known phenomenon on other trees. It is not caused by the fungus which grows on the coconut palm. It is a different thing altogether.

Mr. F. J. de MEL :—Different treatment is required?

Mr. PETCH :—I have not heard of any treatment in any country for such a bleeding disease.

Mr. F. J. de MEL :—Is it safe to leave it alone?

Mr. PETCH :—Not if you are growing it for the timber. If so

Then Tar the Wounds.

But if you are growing it for the fruit or for ornamental purposes you may leave it alone.

Mr. F. J. de MEL :—Will the fungus spread to other trees?

Mr. PETCH :—It is a disputed point altogether whether the things you get in that liquid will do so.

In reply to a question of Mr. W. Dias Bandaranayake, Mr. Petch remarked that the coconut stem fungus would grow on dead sugarcane. They could grow it in a solution of sugar.

Mr. BANDARANAYAKE referred to the bleeding disease of mango trees reported from India.

Mr. PETCH:—That is quite different from this. You have a definite mixture of organisms in the sap that exudes from the jak and mango trees.

Mr. FELSINGER :—In your opinion carbolic acid is effective in killing the fungus?

Mr. PETCH :—If you are quite certain that it will go to every portion of diseased tissue you can be happy.

Mr. FELSINGER :—The application of carbolic will benefit the diseased tree?

Mr. PETCH :—If you are sure it will travel in the wood it will be effective. But here you are working in the dark. It would not get through the tissues.

Mr. FELSINGER :—To what extent will it penetrate?

Mr. PETCH :—That I cannot say.

Mr. G.S. SCHNEIDER :—I wish to know whether the spores would be wind-borne or carried by insects.

Mr. PETCH :—The spores are deep inside the tree and do not come out till the bleeding stage is reached. Then they come in the liquid which is thick and sticky. I do not think the wind has any chance of carrying the spores. They will be conveyed by anything that settles and moves about on the coconut trees—insects, rats, squirrels or men who climb the trees.

Mr. SCHNEIDER :—The fungus begins inside the trunk?

Mr. PETCH :—It works in from the outside through cracks in the bark.

Mr. SCHNEIDER :—I have been to three large estates about a fortnight ago and saw more diseased trees near the bungalows than further afield.

Mr. PETCH :—There is more tendency for the disease to spread in some places. In some places there is more disease round mills than in other parts. I may be able to explain that but not to make a suggestion.

Mr. SCHNEIDER :—Coming down from Chilaw the other day I noticed a large number of fires on plantations.

Mr. PETCH :—There has been a suggestion that you should burn tar in plantations. If the disease is due to insects, that might work, but being a fungoid disease inside the stem of the tree you cannot prevent it by burning tar

Or Making Bon-Fires on Estates.

Mr. SCHNEIDER :—Except to the extent of killing insect carriers.

Mr. PETCH :—Yes. But that is rather remote.

Dr. H. M. Fernando :—How long will the effect of the Bordeaux Mixture last ?

Mr. Petch :—Judging from the Peradeniya results, where the rainfall is about 80 or 90 inches a year, Bordeaux Mixture leaves its effect on the leaf of the cacao tree for a year at least. I should imagine that in the dry districts it will last longer. I certainly expect it to last over a year.

Dr. Fernando :—The suggestion is made as to the desirability of adding some sticky matter to the Bordeaux Mixture to make the solution to stick better.

Mr. Petch :—If we find it washes away we can add some sticky substance. The material added to whitewash to make it sticky will be the best thing to add. They are using Bordeaux Mixture now in the Cameroons, but in spraying their cacao they mix starch in their Bordeaux Mixture.

Mr. Felsinger :—Will the fungus find a congenial home in ashes ?

Mr. Petch :—No.

Mr. Felsinger :—You might destroy the fungus through the final result of the application of a necessary manure or mixture at the roots, through the result of absorption.

Mr. Petch :—Introducing the material into the tree through that means ?

Mr. Felsinger :—Yes ; by manure.

Mr. Petch :—You apply it—

Mr. Felsinger :—In the usual way.

Mr. Petch :—You cannot apply any solution to the roots of the tree and make certain it will go to any part of the tree. We have been trying that. That is the hope of mycologists—to give the root medicine and find that medicine gave any particular branch or in any direction you want it to. Up to the present time this has been found impossible.

Mr. A. K. Beven :—Regarding the bud rot, does the tender frond denote the existence of the disease ?

Mr. Petch :—It might. As a rule the dying of

The Centre Spike Indicates bud Rot.

The straight upright pike in the centre rots away and falls off.

Mr. Beven :—It takes several months before the crown drops off ?

Mr. Petch :—Yes.

Mr. Beven :—And in the meantime the nuts ripen on the tree.

Mr. Petch :—If the disease comes in by any one of the fruit stalks the nuts do not ripen, but drop off.

Mr. Schneider :—Do you think that the tendency of the disease is downwards or upwards ?

Mr. Petch :—More upwards than downwards. Of course the softer tissue is upwards and the flow of sap is upwards.

Mr. A. Bawa :—Do you think that trees which are fertilised with artificial manure less liable to the disease than other trees ?

Mr. Petch :—As far as I can see they are just as liable as other ones. The first plantation I really saw which had the disease had never been manured at all. Since that I saw it on estates regularly that were manured and those which were not manured. The application of manure does not appear to make the slightest difference.

A VOTE OF THANKS.

Practical Demonstration at "Elscourt."

The Chairman :—I do not think there is any other gentleman who wishes to put any questions. And as the hour is getting late, I think we might adjourn to "Elscourt" gardens for the practical demonstration. But, before doing so, I must first apologise for being late, and I express my regrets that I did not hear the first part of Mr. Petch's very interesting and informing paper. I am sure you will all join with me in according him a hearty vote of thanks. I think his paper has elucidated a number of points about which there was some doubt in the minds of the people and the answers to the questions will have helped to dissipate a lot of erroneous ideas in the Press. I think it is well that we have had a good deal of correspondence on the question in the Press, and that the attention of the public has been drawn to this disease. I think that now, after hearing Mr. Petch's paper, we have some definite idea about the disease. As far as I can see, we may take it as certain that the disease is due to a fungus and that trees can be infected with it, and that it is infectious is proved, as far as I can see, beyond all shadow of doubt. As regards treatment, I think we may be satisfied that the treatment which has been recommended has been successful so far as our information goes. With regard to what is to be further done I think that the Society is very anxious to co-operate with the Government and the authorities in doing what they can to

prevent the spread of this disease. And with that view we have contemplated issuing certain forms for reports to different estates and we wish to consult Mr. Petch as to the particulars on which, and the headings under which, he wishes information. Then, again, I think the proprietors of estates in different parts of the country will be only too ready to welcome those persons—inspectors—who are sent out by Government and to help them in every way to do what they can, and to influence the villagers and owners of small properties round about their estates. Also we can assure them that we will be ready to give any further information, if Mr. Petch will only indicate in what way the Society can be of use. We are willing to do what we can. Gentlemen, I wish you to accord a hearty vote of thanks to Mr. Petch. (Applause.)

The CHAIRMAN—further indicated that there were certain specimens of diseased trees and nuts brought all the way from Negombo, which were to be seen on the verandah. They were affected by the kernel disease, he believed. There were also different instruments used for treating them on view.

The adjournment to "Elscourt" for the practical demonstration was then made.

A TOBACCO EXPERIMENTAL STATION FOR JAFFNA WANTED.

Jaffna Tobacco Cultivators appear to see in the institution of an experimental station a sovereign remedy for all the evils of depression which have recently overtaken their industry. They express themselves as unable to help themselves, and want the Government to bear the entire expense of such experiments as they think would place their industry on a sounder and more remunerative footing. We are asked in a letter addressed by the Hon. Secretary of a public meeting recently held under the presidency of the G. A., to support the claim for the engagement of an expert and the institution of an experimental station. We have candidly to say that our faith in tobacco experts has been much shaken by our experience in the past. Ceylon has paid much for "expert" advice and got little of practical value in return. Then it must be remembered that many unsuccessful endeavours have been already made to improve Ceylon's tobacco. The latest case was a European expert from the Straits, Mr. MacDougal Gibson, who was subsidised by keen men of business in Colombo and sent to investigate Jaffna tobacco; but for some reason or other the scheme soon after collapsed and the expert left the island. But far more important is the case of the German or Dutch capitalists and experts (with experience in Sumatra) who came here to buy land and organise a regular plantation and do justice to Ceylon tobacco, after the fortunate sale of Mr. Vollar's maiden-crop of tobacco leaf at a fancy price in London. A great deal of money was spent in this venture by men who knew all about tobacco; much land was bought, a regular plantation was started and continued for some years (?), but eventually abandoned and all the money lost. Tobacco cultivation is undoubtedly the back-bone of Jaffna, and it is true that Sir Henry Blake recommended the employment of an expert by the Agricultural Society; but it is equally true that on the return of Mr. Kelway Bamber from Sumatra His Excellency, on April 2nd, 1906, at a meeting of the Board in Colombo publicly announced that he did not think, in view of the knowledge obtained by Mr. Bamber, that an expert was neccessary. In view of this, we consider that the local Agricultural Society should, in the first place, put their shoulders to the wheel and carry out some experiments through trusted agents before Government is asked to launch out into the ambitious and costly schemes outlined in Mr. Price's memorandum on the subject. Mr. Bamber's acquired knowledge is still available, and no doubt Government would be willing to direct him to give the men of North as much assistance as possible.

THE TOBACCO INDUSTRY OF THE NORTHERN PROVINCE.

A public meeting was held on the 6th instant at 9-30 a.m., at the Bungalow opposite the Jaffna Kachcheri, to consider a proposal to conduct experimental cultivation of tobacco and introduce modern method of curing with a view to relieving the present state of depression in the trade. Mr. F. H. Price, the Government Agent, at whose instance the meeting was convened, presided and there was a large attendance. The Chairman, after preliminaries, explained the object of the meeting. He said that having come to understand that great depression prevailed in the Jaffna tobacco trade on which the prosperity of the Northern Province depended, he collected all the necessary information on the subject and communicated with the Government. They were of opinion

that it was a matter in which the people interested should devise some means for the improvement of the tobacco industry in Jaffna. He had, therefore, called that meeting to lay before it his own views and to know whether the amount required for conducting the proposed experimental cultivation could be raised in the country. He had prepared a memorandum on the subject embodying the facts contained in his communications with the Government. Mr. Harrison Jones then read the memorandum of the Government Agent.

The CHAIRMAN—having called for discussion, Messrs. A. Sapapathy, A. M. Chittambalam, S. Thambiahpillai, and J. H. Vanniahsingam took part in it. Mr. Sapapathy expressed his disappointment at the action of Government in not redeeming the promise made by Sir Henry Blake in regard to the appointment of a tobacco expert to advise and instruct the people in the cultivation of new varieties of tobacco and curing them to suit foreign markets. Without Government aid and initiative it would be impossible to carry on any experiment in Jaffna. As one interested in the Jaffna-Travancore tobacco trade, he detailed its present depressed condition owing to overproduction here and less demand in Travancore. He estimated the difference between the price which the quantity of tobacco exported from Jaffna fetched in that State last year compared with the amount that could be realized by the sale of that quantity according to the reduced price that at present prevailed at 4 lakhs of rupees. Mr. Chittambalam shared Mr. Sapapathy's views in regard to the appointment of an expert and expressed his doubts whether the people, if left to themselves, would be able to do anything to promote the cause of improved tobacco cultivation. He asked why that question should have been taken up by a separate public meeting instead of having been dealt with by the Jaffna branch of the Agricultural Society. He also wanted to. know the result of the experimental cultivation carried on at the instance of Government at Maha-Illuppalama before the Jaffna public were asked to carry on experiments with tobacco cultivation themselves. Mr. Thambiah Pillai suggested the desirability of sending a Jaffna young man at Government expense to Sumatra or to some other tobacco-growing countries to learn modern methods of growing and curing tobacco, in case the Government would not incur the larger expenditure of establishing an experimental station in Jaffna. Mr. Vanniahsingam, in supporting the views of the previous speakers, said that in the existing condition of the country the people would not be able to raise the necessary funds to carry on the experiment.

The Government Agent expressed a desire to leave the consideration and decision of the question to a Committee.

Mr. A. Sapapathy was appointed Secretary.

A large committee was appointed to carry out the object of the meeting. With a vote of thanks to the Chairman, moved by Mr. A. Mailvaganam, seconded by Mr. A. Sapapathy, the meeting came to a close at 10-30 a.m.

THE MEMORANDUM OF MR. PRICE, G.A., N.P., ON TOBACCO.

I place on record the following observations in respect of the tobacco industry in the Northern Province.

2. The future of the cultivation depends to a great extent on the finding of new markets for export, new markets, that is to say, for tobacco for smoking. It does not seem probable that new markets for tobacco for chewing can be found.

3. Here it is convenient to emphasise the distinction between the two descriptions of the tobacco industry in the Northern Province. The production consists of (1) tobacco for smoking, and (2) tobacco for chewing.

4. Dealing first with (2), I may say at once that tobacco for chewing is not the object of my present communication. But, before dismissing it from further consideration, I remark that the demand for this tobacco has recently decreased considerably. The merchants of Jaffna have recently been advised from Travancore and Cochin that the stocks there are at present so large that the usual exports from Jaffna will not be required. The consequence is that there is a large quantity of chewing tobacco in Jaffna which is unsaleable. For this I see no remedy in the immediate future. It may be that in the further future a remedy may be found by divertiug from chewing tobacco the capital, labour, and land at present used in its cultivation, and by applyiug them to the cultivation of smoking tobacco. But this will depend upon the finding of new markets for smoking tobacco.

5. To return now to (1) smoking tobacco. Figures are not available, because much of what is produced is consumed locally; but it is safe to put the production of smoking tobacco at not less than that of chewing tobacco, (say) at 4½ million pounds (page 114 of Report on Ceylon Blue Book for 1906, paragraph 11). It may be safely assumed that the value of the smoking tobacco produced in the Northern Province during 1906 amounts to R450,000. Details of the calculation are given in enclosure A. The value of chewing tobacco exported beyond sea in 1906 was, in round numbers, R915,000 which brings the total value of the (estimated) local production up to R1,365,000. At any rate the annual production represents well over a million rupees.

6 The cost of production has increased considerably, for instance, within the past five years wages have risen by 50 per cent. To increased cost of production and

competition with the Jaffna cigar from two sources: namely, from (1) imported cigarettes, and (2) tobacco grown elsewhere in Ceylon, that is to say, in Dumbara and in Batticaloa. The results are injurious to the local tobacco industry.

7. Tobacco is the backbone of the Northern Province, and the improvement of its cultivation is of more importance than any administrative or legislative measures. This was the view of Mr. Ievers in 1899, repeated in 1900 (Administration Reports 1898 page D5 and 1899 page D4.) Experimental cultivation under proper guidance is what is wanted' for if the people see that tobacco cured in the modern methods fetches a higher price, it may induce them to follow these methods and obtain a more extensive market. (Administration Report for 1901 page D6).

8. What would the experiment cost? I have reason to believe that the expenditure required for one year might amount to (say) R65,000.

NOTE.

The figure R65,000 is based on the following calculation. In order to cure tobacco for the European market, it is necessary to cure it in *large* quantity, and it has been estimated that the product of about 15 acres would be required, or at say R500 an acre, R7,500 for each cure. One would want at least four attempts probably which with curing would cost R45,000. To this must be added the salary and travelling expenses of an expert curer. It might be possible to get a really good man for say £890 for the season This with travelling expenses would mean £1,000 and contigencies would account for the rest.

2. The most recent publications say that the produce of 4 to 5 acres is enough for a cure. This would reduce the cost to R15,000 if Jaffna tobacco were employed, or say R35 to R40,000 in all. Even this is a good deal and as Mr. Gibson's experiments have given reason to doubt whether Jaffna tobacco can *ever* be cured to suit the European palate, it is doubtful if it is worth while going any further with Jaffna leaf than doing what can be done to improve it for the local and Indian market.

3. Cuba and other thin-leaved tobaccos will grow in Jaffna, and on the lands under some of the tanks, e.g. Maha-illuppalama. Years ago Cuban tobacco was tried at Jaffna, but the people dug it up and threw it away when they saw the delicate leaves. To get it grown it would be necessary to pay the growers what they get for an acre of Jaffna.

4. A cheaper experiment will be to grow 10 acres in the Jaffna district of good Cuban or Sumatran leaf. This would cost say R5,000 to bring into bearing, and perhaps another R6,000 to cure. Adding R4,000 for seed and sundry expenses, and R15,000 for an expert, the total comes to R30,000 which appears to be about the lowest figure at which it could be done.

THE POSITION AND PROSPECTS OF THE RUBBER PLANTING INDUSTRY.

By Mr. M. Kelway Bamber, F.I.C., &c.

"The Rubber Producing industry of Ceylon and Malaya is still expanding, though rather less rapidly than a year ago. The fall in the price of Rubber, from whatever cause, will be of service to the planting industry in restricting future openings to the most favourable positions only, where soil, climate and labour conditions are of the best. It will also encourage the finding of new markets and uses for Rubber, and will favour economies in production, which might otherwise be neglected. Many lessons of the greatest value have been learned from the experiences of older plantations and, profiting by these, future extensions promise well as a sound investment. While the importance of purity in the product is fully realised and generally aimed at, there is still some uncertainty as to the best form in which to put the Rubber on the various markets, and until manufacturers definitely decide this point, variations will continue. The value of *uniformity* in the product of any plantation cannot, however, be over-rated. Notwithstanding the gradual fall in the price of Rubber owing largely to the financial trouble in the United States of America, the British-grown product still maintains the lead owing to its reputation for purity and careful preparation. This can easily be maintained, and with further experience in tapping and preparation, and with an increasing proportion of older trees in bearing, satisfactory profit should be ensured to the producer for many years to come, even should the price of Plantation Rubber fall to 3s. per lb. Whether or when the price will fall to this figure it is impossible to say, as the consumption of the article seems likely to increase rather than otherwise, owing to the number of uses to which Rubber is and can be put in various industries."

January, 1908.

—*Rubber Producing Companies.*